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CONTENTS.

Authors are alone responsible for their respective statements.

No. 1. *January.*

PAGE

Mesopotamia: Past, Present, and Future. By Sir William Willcocks, K.C.M.G. (with 5 Plates and Map) 1
Journeys in Bhutan. By J. Claude White, C.I.E. (with 10 Plates and Map) 18
The Development of Wheat Culture in North America. By Prof. Albert Percy Brigham 42
Floods in the Great Interior Valley of North America. By Miss Luella Agnes Owen 56
The Volcanic Eruption in Teneriffe. By Dr. John S. Flett 59
Central Asian Archæology. By C. H. H. 61
Dr. Longstaff's Himalayan Expedition, 1909. By Dr. Tom G. Longstaff .. 64
Reviews:—
ASIA 66
AFRICA—The South Central Sahara 66
AMERICA—The Conquest of Mexico 68
AUSTRALASIA AND PACIFIC ISLANDS—Australian Meteorology 70
POLAR REGIONS—Baron Toll's Last Expedition 71
GENERAL—Stanley's Autobiography. Text-Books 72
The Monthly Record 76
Meetings of the Royal Geographical Society, Session 1909–1910 85
Geographical Literature of the Month 88
New Maps 100

MAPS.

Map of the Tigris-Euphrates Delta 104
Map of Sikkim and Bhutan, with Parts of Adjacent Countries 104

No. 2. *February.*

The Hispar Glacier (with 7 Plates and Map)—
I. Its Tributaries and Mountains. By Fanny Bullock Workman, F.R.S.G.S., Officier de l'Instruction Publique de France 105
II. Prominent Features of its Structure. By William Hunter Workman, M.A., M.D., F.R.G.S. 115
A Naturalist's Travels on the Congo-Zambezi Watershed. By S. A. Neave, M.A., B.SC. OXON (with 4 Plates and Map) 132
The Cycle of Mountain Glaciation. By Prof. William Herbert Hobbs, University of Michigan (with 7 Diagrams and 7 Plates) 146
Survey Work on the Bolivia-Brazil Boundary. By Major P. H. Fawcett, R.A., Chief Bolivian Commissioner 163
Notes on Journeys taken in the Kalahari Desert. By Arnold W. Hodson (with Sketch-map and 4 Illustrations) 166
The Norwegian Sea. By Leon W. Collett 172
Reviews:—
EUROPE—Austria-Hungary. The North European Seas. The Baltic .. 179
ASIA—Sikkim and Bhutan 182

PAGE

AFRICA—African River Vegetation. The Oasis of Aïr and its Inhabitants 184
AMERICA—Mexico. Mexico and Yucatan 188
AUSTRALASIA AND PACIFIC ISLANDS 191
GENERAL 191
The Monthly Record 193
Obituary—H.M. King Leopold of Belgium. Colonel George Earl Church. Prof. H. H. Giglioli. Lieut.-Colonel A. E. G. Watherston, C.M.G. 202
Meetings of the Royal Geographical Society, Session 1909–1910 206
Geographical Literature of the Month 207
New Maps 220

MAPS.

Sketch-map—Mr. Arnold W. Hodson's Routes in the Kalahari Desert 167
The Hispar Glacier and Tributaries in the Karakoram Range 224
Map of Northern Rhodesia and Adjacent Territories 224

No. 3. *March.*

A Journey in North-Western Arabia. By Douglas Carruthers (with 7 Plates and Map) 225
Notes on Kordofan Province. By Captain Watkiss Lloyd, The Cameronians (Scottish Rifles), late Governor of Kordofan (with 8 Illustrations and Map) 249
The Cycle of Mountain Glaciation. By Prof. William Herbert Hobbs, University of Michigan (with 5 Plates and 10 Diagrams) 268
A Tour in the Liberian Hinterland. By Captain Braithwaite Wallis, F.G.S., F.R.G.S., His Majesty's Consul-General at Dakar, lately H.M.'s Consul-General for Liberia (with Map) 285
Project of a Danish Expedition to the Central Eskimo. By Knud Rasmussen 295
Notes on Determination of Position near the Poles. By Arthur R. Hinks, Royal Geographical Society Lecturer in Surveying and Cartography, Cambridge University (with Diagram) 299
The Forests of British East Africa. By M. H. 313
The Annual Meeting of the Geographical Association. Address by the President, Douglas W. Freshfield 314
Geography at Oxford 316
The Capital of the Australian Commonwealth (with 3 Sketch-maps) 318
Reviews :—
EUROPE—Iceland 321
ASIA—Tibet. A Japanese Pilgrim in Tibet 322
AFRICA—The Partition of Africa. South African History 325
AMERICA—Panama and Ecuador. Explorations in Southern Brazil 327
Expedition of H.R.H. the Duke of the Abruzzi to the Karakoram 330
The Monthly Record 332
Meetings of the Royal Geographical Society, Session 1909–1910 339
Geographical Literature of the Month 340
New Maps 350

MAPS.

Sketch-map of North-West Arabia 356
Map of the Sudan Province of Kordofan 356
Prismatic Compass Traverse in Liberia 356

No. 4. *April.*

Journeys in Kurdistan. By Captain Bertram Dickinson (with 6 Plates and Map) 357
The Sand-dunes of the Libyan Desert. By H. J. Llewellyn Beadnell, F.G.S., F.R.G.S., ASSOC. INST. M.M., formerly of the Geological Survey of Egypt (with 4 Plates, Sketch-map, and Diagrams) 379

PAGE
Problems in Exploration—Central Asia. By Ellsworth Huntington 395
The Present Trend of Geography in the United States. By R. H. Whitbeck, University of Wisconsin, Madison 419
Egyptian Irrigation. By Colonel Sir Colin C. Scott Moncrieff, K.C.M.G., K.C.S.I. 425
New Light on Verrazzano's Voyage of 1524 428
A Contribution to Geographical Bibliography. By F. S. A. 430
Reviews :—
EUROPE—The North Sea. Crete 433
ASIA—The Western Himalaya 435
AFRICA—Abyssinia. Uganda and the Sudan. The Heart of Central Africa 436
AMERICA—Chile. Chilean Surveys 439
POLAR REGIONS—Antarctic Meteorology 440
MATHEMATICAL AND PHYSICAL GEOGRAPHY—The North Atlantic 442
GENERAL—Text Book. Sir Charles Wilson 443
The Monthly Record 445
Obituary—Colonel Claude Reignier Conder, R.E., LL.D. 456
Correspondence—The Altitude of Mount Huascaran. By Fanny Bullock Workman. Mesopotamian Trade—Noah's Flood—The Garden of Eden. By Sir William Willcocks, K.C.M.G., and H. Rassam 458
Meetings of the Royal Geographical Society, Session 1909–1910 460
Geographical Literature of the Month 441
New Maps 475

MAPS.

Sketch-map of Approximate Distribution of Sand-dunes of the Libyan Desert 381
Sketch-map of Part of Kurdistan 480

No. 5. *May.*

The Travels of a Botanist in South-West Africa. By H. H. W. Pearson, M.A., SC.D., F.L.S., Professor of Botany in the South African College, Cape Town (with 5 Plates and Map) 481
Explorations in Bolivia. By Major P. H. Fawcett, R.A. (retired) (with 6 Plates and Sketch-map) 513
Progress of Survey in the Anglo-Egyptian Sudan. By Captain Hugh D. Pearson, R.E., Director of Sudan Surveys (with Sketch-map) 532
The Danish North-East Greenland Expedition, 1906–8 : Provisional Results. By Dr. J. Lindhard (with Sketch-map) 541
The Opening of the Oceanographical Museum at Monaco (with Illustration) 558
The Royal Commission on Canals and Waterways 565
Some Recent Changes in the Course of the Trent. By Bernard Smith, M.A., F.G.S. (with 5 Diagrams) 568
Musil's Explorations in Northern Arabia, 1908–9 (with Sketch-map) 579
Reviews :—
EUROPE—France 582
ASIA—Asia Minor. Ceylon. Northern China. East and Central Sumatra 583
AFRICA—Exploration and Sport in Eastern Equatorial Africa 586
AMERICA—The Chile-Argentine Frontier. Southern Chile 588
GENERAL—A Bibliography of Ptolemy's Geography 590
The Monthly Record 591
Obituary—Alexander Agassiz. By Sir John Murray 602
Correspondence—Desert Sand-dunes. By Captain David Comyn 605
Meetings of the Royal Geographical Society, Session 1909–1910 605
Geographical Literature of the Month 606
New Maps 614

MAPS.

Anglo-Egyptian Sudan positions geographically fixed by the Sudan Survey Department 535

PAGE

Sketch-map showing the Surveys of the North-East Greenland Expedition, 1906–8 545
Sketch-map showing Explorations in Northern Arabia 580
Map of South-West Africa 620
Maps to illustrate a paper on Explorations and Boundary Surveys in Bolivia 620
Sketch-map of the Aboinia River 620

No. 6. *June.*

Death of the King. By Major Leonard Darwin, President R.G.S. (with Portrait).. 621
Glacier Exploration in the Eastern Karakoram. By T. G. Longstaff, M.A., M.D. OXON (with Diagrams, 6 Plates, and Map) 622
The Geographical Factors that control the Development of Australia. By Prof. J. W. Gregory, F.R.S. (with Map) 658
The River Uaupés. By Hamilton Rice, B.A., M.D., F.R.G.S. (with 4 Plates and Map) 682
The Cambridgeshire Rivers. By the Ven. W. Cunningham, D.D., Archdeacon of Ely (with 2 Sketch-maps) 700
Canada's Farthest North. By Miss Agnes Deans Cameron (with Illustration) 705
Reviews:—
ASIA—The North-Western Borderlands of India. Western China 708
AFRICA—South Africa 711
GENERAL—Bibliography. Educational Books. Military Geography .. 714
The Monthly Record 717
Obituary—Dr. W. B. Cheadle 727
Correspondence—The True Boundaries of the Continents. By E. Fennell .. 728
Meetings of the Royal Geographical Society, Session 1909–1910 729
Geographical Literature of the Month 729
New Maps 740

MAPS.

Diagram of Peaks of the Karakoram 625
Map of Changes in the Cambridgeshire Rivers after the Stoppage of the Outfall at Wisbech in 1236.. 701
Map of Cambridgeshire Rivers in Roman Times 702
Map of Explorations in the Eastern Karakoram 744
Map to illustrate Paper on the Development of Australia 744
Map of the River Uaupés 744

The

Geographical Journal.

210881

No. 1. JANUARY, 1910. Vol. XXXV.

MESOPOTAMIA: PAST, PRESENT, AND FUTURE.*

By Sir WILLIAM WILLCOCKS, K.C.M.G.

"Out of Eden came a river which watered a garden, and from thence it was parted and became four heads." Plans and levels in hand, starting from the spot where Jewish tradition placed "the gates of Paradise," I have followed the traces of the four rivers of the early chapters of Genesis. Appointed by the new Turkish Government to engage engineers and survey and level the rivers and canals of the Tigris-Euphrates delta, and devise projects for the rehabilitation of the country, I first set myself the task of mastering the ancient systems of irrigation, improving on them when I could, and adopting them when I could find no better substitute. I started with the Garden of Eden.

The Euphrates enters its delta a few miles below Hit, at the gates of Babylonia, where Cyrus the Younger's army, accompanied by the ten thousand, left the deserts and entered the alluvial plains which terminate at the Persian gulf. What the gates of Babylonia were to one descending the Euphrates, the gates of Paradise were to the early livers in the Babylonian plains.

Upstream of Hit, past Anah, the river is to-day a series of very indifferent cataracts, where the current turns giant water-wheels which lift water and irrigate the narrow valley to the edge of the desert. Garden succeeds garden, orchards and date groves lie between fields of cotton, and life and prosperity are before us wherever the water can reach. I do not think it possible to imagine anything more like a practical paradise than the country near Anah. Every tree and crop must have been familiar to Adam except the cotton crop. Though to-day, owing to the degradation of the cataracts, a degradation whose steady progress was noticed by the writers of the Augustan age,

* Read at the Royal Geographical Society, November 15, 1909. Map, p. 104.

water-wheels are necessary to irrigate the gardens; it is easy, indeed, to imagine the condition of the river when the cataracts were such as we see on the Nile, and water could be led off from above a rapid and utilized for irrigating, with free flow, gardens situated a little downstream and above the reach of the highest floods. Such was the Garden of Eden, and its site must have been near an outcrop of hard rock like we see at Anah, where, in coming down the river, we first meet the date palm, which even to-day is a tree of life to the whole Arab world.

Below Hit no place can be found for a garden without lifting apparatus and protective dykes, because otherwise any garden irrigated in the time of low supply would be inundated in flood, and, if irrigated in flood, would be left high and dry in the time of low supply.

Downstream of the garden the river was parted and became four heads. The first was Pison, represented to-day by the many-armed depressions of Habbania and Abu Dibis between Ramadi and Nejef, which are not inaptly described, from the point of view of a dweller in Babylonia, as encompassing the whole land of Havilah which lay between the frontier of Egypt and Assyria.

The second river was Gihon, the modern Hindia, the Chebar of Ezekiel, who lies buried on its banks, the Ahava of Ezra, the Pallacopus of Alexander, and the Nahr Kufa of the early khalifs. It is represented as encompassing the whole land of Kis or Kutha or Cush, the father of Nimrod, the beginning of whose kingdom was Erech and Akkad and Calneh and Babylon. The ancient town of Kutha lay on the Nahr Kutha, which was in all probability the main stream of the Euphrates in the earliest times, and on whose banks were situated Kutha, Nil, Niffur, Erech, and Tel Senkere, which date from days long prior to Babylon, the capital of Khammurabi, founded on the Babylonian branch when the other had silted up.

The third river was Hiddekel, the modern Sakhlawia branch, some 250 feet wide and 25 feet deep to-day, running like a millrace into the wide Akkar Kuf depression, and flowing out of it into the Tigris at Baghdad. If left alone, the Sakhlawia would be capable of carrying more than half the waters of the Euphrates, and rendering the country between the two rivers uncultivable. In ancient times it was undoubtedly a second head to the Tigris, and from the point of view of a dweller in Babylonia, it was accurately described as "that it is that goeth in front of Assyria."

And the fourth river was Euphrates. No definition was necessary. It was the river of Babylon itself.

Just as the Babylonian colonists carried the name of Tigris with them to Nineveh, so doubtless, in times after the most ancient, they gave the name of the river of Babylon to the great stream on whose banks was situated the cradle of the race. From source to mouth one river became the Euphrates, and the other the Tigris.

The Tigris enters its delta at Beled, south of Samarra, over the ruins of one of the most interesting works of antiquity. In ancient days some giant, local tradition says Nimrod, closed the channel of the Tigris by an earthen dam and turned the river over the hard conglomerate, forcing it to flow at a high level and irrigate the whole country. Coursing down over rapids, the Tigris became navigable at Opis; and from there past the modern Baghdad and on to Kut it kept within the channel of to-day. From Kut on to Ur of the Chaldees, past Tel Lo, the ancient Tigris followed the line of the modern Hai or Garraf branch. The country past Amara and Gurna on the modern Tigris was an immense sheet of fresh water known as the Susiana lake. The levels of the country prove this beyond the question of a doubt.

The junction of the Tigris and Euphrates was at Ur of the Chaldees; and from there the joint waters of the two rivers flowed past the modern Zobeir and down the Bubian channel of the Khor Abdalla. The 3-fathom line depicted on the British Admiralty charts clearly shows the ancient mouth of the river north of Koweit. The Khor Abdalla has two heads, one represents the joint waters of the ancient Tigris and Euphrates, and the other the mouth of the ancient Karun.

The Karun river has played no small part in the formation of the Tigris-Euphrates delta. While the Tigris and Euphrates have left all their deposit behind in the Babylonian, Chaldean, and Susiana marshes, the Karun has always hurried down from the Persian hills and carried its silt-laden waters into the Persian gulf or into the joint stream of the two other rivers. It has been the sole factor in forming the comparatively high-lying land which stretches from Basra eastwards. This tongue of land protects the Tigris-Euphrates swamps from the inroads of sea-water, and keeps them fresh. The Basra bar is formed almost entirely of Karun mud. The Tigris and Euphrates mud lies far away to the west.

The ruins of all the more ancient cities lie near the junction of the Euphrates and the ancient Tigris at Ur of the Chaldees. The two rivers had left their deposits in the extensive marshes higher up their course, and the earliest settlers had to do with opaque water, rich in chemical matter, but free of silt, which would have necessitated the presence of many hands to keep their canals clear. A comparatively small population could begin and continue the development of the country, and it was not until the inhabitants became really numerous that the silt-laden waters higher up the rivers were taken in hand.

The lands in the marshes so reclaimed and cultivated became extraordinarily productive, as we see to-day. They were valuable enough to be protected from floods by immense dykes running along the banks of the rivers, which can be followed to-day for miles upon miles, with a width never under 100 feet.

The great value of water free of silt for the early development of the country is the first serious lesson I have learned from an examination

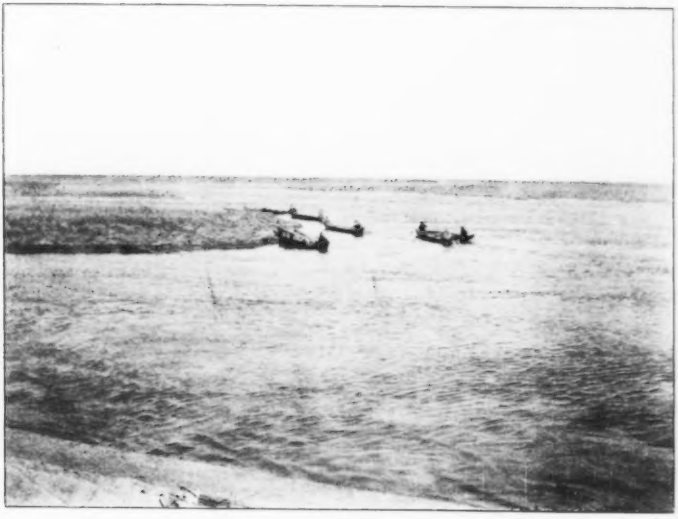
of the ancient systems of irrigation, and you will see later on how we propose to utilize this knowledge.

The Tigris and Euphrates carry in flood during a few days every year over four times as much silt as the Nile. Irrigation with such water will be no easy task even to-day. It was terribly difficult in the old days when they had no cement, and were ignorant of every kind of weir or barrage except an earthen dam completely shutting off the waters and causing convulsions among the people living lower down.

While the development of the country was confined to the low-lying lands blessed with water clear of silt, everything in the delta went on smoothly enough. Pressure of population made the work of development advance into the parts where there was no clear water, and then the difficulties began. In the language of Genesis, the world became full of violence. A strong central government could only have dealt with the question, and there was no strong government. Now the Euphrates and Tigris floods come down with extraordinary force, and both rivers, but especially the Euphrates, overflow their banks in a way a dweller in the Nile valley could have no knowledge of. Joseph's famine would have been impossible in the Tigris-Euphrates delta. Noah's flood would have found no place in Egypt.

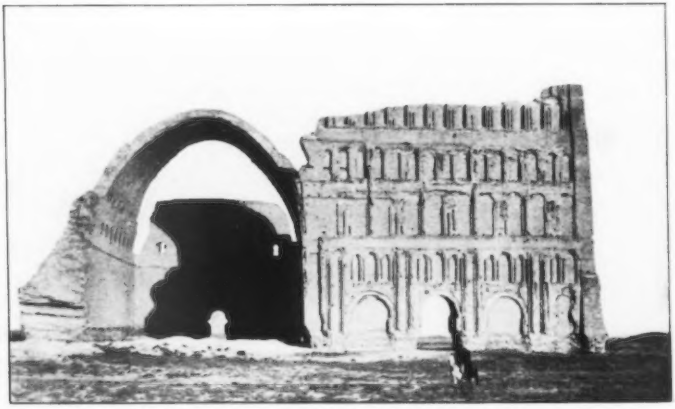
As men crowded up the two rivers, the necessity of protecting themselves from the floods and at the same time keeping their canals free of silt, compelled the early more powerful communities to resort to the only kind of regulation they knew of, and that was the bold one of bodily shutting off the waters of certain of the branches by earthen dams. Judging from the levels, I should say that the first head to be shut off was that of the Hiddekel, or the modern Sakhlawia. Until this was closed nothing could be done with the upper half of the delta. The struggles between the different communities, and the terrible consequences which might result, intimidated the more thoughtful members of the community, of whom Noah was one, and he prepared for the worst. He built an ark of the poplar wood so common in the Euphrates valley, and pitched it inside and out with bitumen from Hib, just as the boats and corracles on the Euphrates are pitched to-day. A settler probably in the lower part of the delta south of Kerbela, where the deserts, moreover, are strangely degraded and low, he felt the full force of the inundation. A massive earthen dyke was thrown across the head of the Sakhlawia, the flood discharge of the Euphrates was doubled, and instead of the waters rising 16 feet, as in an ordinary inundation, they rose 15 cubits, or 24 feet, and not only was the cultivated land under water, but the deserts themselves were submerged. To men living in the Euphrates valley and in the valley of the Nile, the word "jebel" does not represent a hill, but the desert. In the English translation the word "mountain" represents something those people never saw.

AN ISLAND IN THE EUPHRATES NEAR ANAH.
(*Photo by Percy L. Lonsdale.*)



THE WATER RETURNING FROM THE SWAMP TO THE RIVERS.

UNIRRIGATED MESOPOTAMIA.



NAUSHERWAN'S PALACE, CTESIPHON.

In the Arabic translation it is properly called the "jebel." A rise of water of 15 cubits could put no hill, leave alone a mountain, under water.

While travelling in Upper Egypt I have often been asked by the less-informed sheikhs whether England was irrigated by basins or by watercourses. On my replying that England had no irrigation at all, the remark has invariably been, "Then, how do the people live in the 'jebel?'"—pronounced "gebel" in Egypt. As Director-General of land tax adjustment in Egypt, I was once valuing the lands in a large basin, in the middle of which was a small desert mound some 2 acres in extent and 4 feet high; on my suggesting that we might ignore so insignificant a patch of land, I was told that you could not tax the "gebel." Mentioning these facts to Colonel Ramsay, the British resident at Baghdad, and to Mr. Van Ess, the Basra missionary, who were travelling with me, and just then on a steamer in the Nejef marshes, we agreed to test the matter on the Euphrates. Approaching Shinafia, we saw the low degraded desert on the horizon, and asked our boatmen what that was; they immediately replied, "The jebel." It was no more like a hill than Ludgate Hill is like a mountain.

Floating off in all probability from near Kerbela, where one of the shrines of the patriarch very properly stands to-day, and driven by the current and the wind, both steady from the north, the ark drifted southwards and wandered long in the Chaldean marshes. Finally it touched land, probably somewhere near Ur of the Chaldees, on the edge of the desert. I say Ur of the Chaldees, because it is here that we find Terah, the father of Abraham and the representative of the patriarch's family. I think readers of the Bible will agree with me that the representatives of the patriarchal families were a stationary kind of people in place and habits. It was the Cains and Tubalcains who moved about, undertaking new pursuits and making discoveries. The fact that Abraham, the friend of God, should have wished to move made him a marked man, and earned him his name of Hebrew.

Ararat was the name of the desert mound where the ark rested; and when the families of the younger sons of the patriarch moved off and made new settlements, they gave the name of Ararat to the highest mountain they knew, in honour of the spot where the ark rested. This Armenian Ararat could no more have been the Ararat where the ark rested than New York be York.

As I have tried to depict these early events, everything has been looked at from the point of view of the dweller in the Babylonian or Chaldean plain. And this is in accord with the opinion of the time. My friend, the Rev. Prof. Sayce, has shown me a copy of a Chaldean map of Abraham's time, in which the Earth lies round Babylon as a centre.

In following the history of the delta, the second lesson we have learned is the necessity of controlling the floods of the Euphrates if any serious development of the country is to be undertaken.

The dwellers in the Euphrates delta, tired of anarchy and confusion, gladly welcomed any strong man ready to produce order and method in a country which could not exist without order and method; and they found their "mighty one" in the person of Nimrod, according to Genesis, or Khummurabi, according to the tablets. The dwellers in the delta to-day are in the same position. I have seen eight hundred armed peasants, all Arabs, volunteer to help the Government troops to keep order. Every Arab family, like that of Isaac, has some of its sons after the peaceable Jacob and some after the Beduin Esau. In Mesopotamia to-day the would-be agriculturists have little chance, for whenever they desire to settle, down comes a mighty flood and converts them into wanderers. Let the floods be controlled and the irrigation works begin operating, and it will be seen that those on the side of order are more numerous than those against it, and moreover far more earnest.

This dispute between the agriculturists on the one hand and the shepherds on the other is as old as the feud between Cain and Abel. About May 5 this year, when the flood was at its highest, I was riding up the left bank of the Euphrates from Ramadi to Hit, and counted over fifty flocks of sheep of about 200 each, or 10,000 sheep in all, walking into the valley from the desert. The appearance of the shepherds made the agriculturists alert, and on my way down the river in a boat the next day I heard two shots fired quickly one after the other, and in an instant the cultivated plain was covered with men on horseback and on foot rushing to the spot, some with spades and some with guns. They were prepared to fight the Beduin shepherds or the flood. Meeting one of the head sheikhs, I asked him why they could not arrange to let some of the land be inundated and some put under wheat and barley; he said that they could not agree among themselves, but would be pleased to see some order and method instead of the eternal feud. He added that if working rules were laid down, the agriculturists were sufficiently numerous to insist on their being respected.

All the early kings who did anything worth recording have left memorials of the canals they constructed, to which they gave names strangely similar to the "Kanatir il Khairia," or "Bridge of Blessings," which the Egyptians apply to-day to the first barrage constructed on the Nile.

As population increased we hear of reservoirs for storing water for perennial irrigation, especially for the important Arakhtu canal which came down from Sippara and irrigated Babylon.

It is recorded of Cyrus the Great that he too utilized his army for digging numerous canals from the Gyndes or Dyala. Many of these canals are in use to-day.

Herodotus gives a picturesque and glowing description of Babylonia in B.C. 480.

Some fifty years later, Xenophon, as becomes a disciple of Socrates,

gives an exact description of the country as he saw it. Book in hand, I have followed his march in the delta from "the Gates" to Opis, and I here give my impressions. Cyrus the Younger's army entered the delta at the Gates already described, and crossed the valley of the Sakhlawia by the great earthen embankment which from all antiquity stretched from desert to desert and kept the Euphrates within its own valley. Cyrus anticipated the reopening of the branch by Artaxerxes, who had dug a new canal down the valley of the Sakhlawia, trusting to the steep slope to soon scour out an impassable barrier to his brother's army. Hurrying along the dyke, the army of Cyrus entered the desert plateau of 110 square miles in extent which lies between Feluja and Baghdad, and over which Artaxerxes' army advanced under thick desert dust which looked like a white cloud. Xenophon saw the first of the four canals, known in the times of the Khalifs as the Issa, the Sarsar, the Malik, and the Kutha, which leave the Euphrates south of this desert plateau. The first is in very deep digging in the desert. He saw no more, and spoke from hearsay of the rest, for he is wrong in every particular, a circumstance rare with him. Mind, he does not say that he saw them. The canals are not the same size, they are by no means the same distance apart, and they do not run from the Tigris to the Euphrates. In this reach the Euphrates is 25 feet higher than the Tigris. The battle of Cunaxa could not have been fought south of the desert plateau, as the country was intersected by four large canals and countless deep watercourses, and was, moreover, heavily irrigated. Armies accompanied by large bodies of cavalry, chariots, and baggage-waggons could not have moved at all, leave alone manœuvred and fought. After the battle the ten thousand retreated in a north-westerly direction, with the rising sun on their right hand, and were entangled in the watercourses fed by the new canal just dug by Artaxerxes and now opened. North of Tel Safêra there are no dykes or trenches going northwards. The Median wall, I think, stretched from Tel Safêra to Akkar Kûf, and from there to Coche on the Nahr Melcha, opposite Ctesiphon. It protected Babylonia from the Assyrians first, and then from the Medes in the pre-Persian days; it took the place of the Sakhlawia branch, which, as already twice stated, was closed from the earliest times. Artaxerxes opened his canal in August, during the time of low supply, or there would have been a catastrophe.

Keeping south of the Median wall, the ten thousand crossed over to the north at some point west of Akkar Kûf, and, winding their way round the Akkar Kûf depression, crossed two canals, both coming from the Tigris near Nimrod's dam. The latter was the Izhaki canal, on whose east bank was Sitaki, not far from the modern Kazimain. They crossed the Tigris by a bridge of boats with the same number of boats that the Baghdad bridge had a few years ago, before it was replaced by the present one of larger boats. From here they had to leave the river,

as the country was heavily irrigated by the numerous canals, into which Cyrus the Great had led the Dyala. The troops with the transport waggons had to follow the road, which doubtless then, as now, went to Bakuba, and so the distance covered was 50 per cent. in excess of the bee-line which commentators ordinarily measure along. At Opis they crossed the Physcus, or Adhaim river by a bridge 100 feet long, and entered desert country. At Manjur, which Captain Felix Jones, of the Indian navy, unerringly stated to be the site of Opis, the Adhaim river flowed into the ancient Tigris before the river burst into its present channel. Immediately to the north of this point we leave the alluvium of the Tigris, and enter the unirrigable marls which Xenophon called deserts.

Alexander's historians give a vivid description of the irrigation of the country and the difficulty the Babylonians had in closing their canals in flood and clearing them in low supply. They described the closing of the canals in flood as by far the more difficult operation. Alexander entered into the work with all his energy and genius, and to-day we can only admire the judgment with which he treated the Hindia branch or the Pallacopus, and the promptitude with which he acted. The whole of the waters of the two rivers was used for irrigation in all but the flood season, and Alexander had to remove the earthen barrages thrown across the Tigris before his fleet could sail up the river from the sea.

In the time of the Sassanian kings of Persia, in the early centuries of the Christian era, the delta probably saw its greatest prosperity. The gigantic Nahrwan canal, 400 feet wide and 15 feet deep, irrigated all the country to the east of the Tigris, and the Dijail irrigated that to the west. The Euphrates gave off the four canals already mentioned by Xenophon, and canals fed by the Babylonian branch from near Babylon irrigated the country right up to the ancient Tigris, or the modern Hai branch. Ammianus Marcellinus, who traversed the whole length of the delta in the fifth century of our era, describes the country as a forest of verdure from end to end.

The centres of development varied from period to period. While during the earliest times, Tel Lo, Senkere, and Ur of the Chaldees were the heart of the country; Sippara and Babylon took their place in Babylonian times; and Opis and Ctesiphon in that of the Persians.

In the seventh century of our era, the Arabs overthrew the Persian Government, and substituted Kufa, Wasit, and Basra, as capitals in place of the earlier cities. These soon gave place to Baghdad, which till to-day has remained the most important town in the delta. Baghdad saw its greatest days about A.D. 800, in the reign of Haroun-el-Rashid. Under the Arabs, the prosperity of the country steadily declined, but the final blow was given by the Mongols under Zengis Khan and the Tartars under Timur in the thirteenth and fourteenth centuries. Previous disasters had drenched the country in water; it was now

BASRA CREEK.
(*Photo by Percy L. Loraine.*)

SOUTH ROAD IN BAGHDAD.

RUINS AT BABYLON.

THE GATE OF ISTAR AT BABYLON.

drenched in blood. In the anarchy and confusion which ensued, all the great works of antiquity were swept away one after another, until not a single one remains to-day. Nimrod's earthen dam on the Tigris was breached, and the level of the water in the river fell some 25 feet, leaving the great Nahrwan and Dijail canals dry and waterless. Both banks of the Tigris in the upper part of the delta became a desert. The Tigris, lower down its course, fared no better. Near Kut, the river breached its left bank and wasted itself in the marshes on the Persian frontier, while the ancient channel past Wasit and Tel Lo received a limited supply of water only in flood-time. The ancient dyke across the Sakhlawia branch of the Euphrates was breached, and Western Baghdad with its irrigation system was wiped out. All the canals taking water from the Euphrates which had come down from a remote antiquity, the Issa, Sarsar, Melcha, Kutha, Araktu, Surat, Nil, and Nars, silted up and ceased running; and finally in our day the Euphrates of Babylon has dwindled into an insignificant stream, and the whole of the waters of the river are flowing through the Nejef marshes. The Tigris and Euphrates, left to themselves, have deserted the high lands which they irrigated in old days, and are now traversing the lowlands and marshes along the extreme east and west of the delta.

Things would have been far more desperate than they actually are had not a new crop been introduced into the country, which has permitted of large areas of swamp being turned into valuable fields. When rice first appeared in the delta no one can tell, but it is the most valuable crop in the country to-day after the date crop.

The delta of the two rivers has an area of some 12,000,000 acres, of which about 9,000,000 are desert, and 2,500,000 acres freshwater swamp. In the upper parts of the delta there are stretches of cultivation along the river-banks in places, and along a number of small canals; but in the lower part of the delta there are magnificent reaches of date groves and gardens interspersed with clover and cereals, and large areas under rice in flood.

We have seen that the earliest settlers in the delta clustered round the reaches of the rivers where the water was free of silt. It is the same to-day. This water, though free of sand, is opaque in colour, and retains the rich chemical ingredients so necessary for agriculture. It is totally different from the dark-looking, transparent water which has stagnated in the marshes.

The rainfall is on the average about 8 inches per annum. The whole of the rain falls in winter, and there have been years in succession when the total fall has not exceeded 4 inches. Of such tracts, President Roosevelt, in his first message to Congress, has well said, "In the arid region it is water, not land, which measures production." We therefore turn to the amount of water in the two rivers. The Euphrates has a high flood of 120,000 cubic feet per second, and a low supply of 10,000

cubic feet. The corresponding figures for the Tigris are 180,000 and 10,000.

The rivers are in flood in March, April, and May, while August and September are the months of low supply. We may, without the aid of reservoirs, count on 6,000,000 acres of winter crops, and 3,000,000 acres of summer crops. We shall have wheat, barley, and beans in winter, and cotton, Indian corn, and rice in summer. To-day, if the winter rains are above the average, large areas of land are put under barley, for the deserts of Mesopotamia are not deserts like those of Egypt, but in great part steppes capable of supporting millions of sheep. The date palm is at home everywhere in the delta, while the Basra groves are credited with ten million trees. Dates and wheat are considered as growing wild at Anah.

The winter is severe, and the summer is very hot and prolonged. Live stock of every kind is abundant, and of superb quality. Old Mahomed Pasha il Daghistani has two hundred Arab mares in his studs at Azazia, on the Tigris. Live stock will always be one of the principal exports of the country.

The delta is strangely flat. Baghdad, removed some 500 miles from the sea, is only 115 feet above sea-level. Opposite Baghdad the Euphrates is 25 feet higher than the Tigris. Between the two rivers runs a regular valley, across which are carried the giant banks of the ancient canals like miniature hills.

The waters of the two rivers and the soil of the country are yellow in colour, and very different to the black soil of Egypt. The percentage of lime in water and soil is as high as fifteen, and consequently the soil is far more friable than the stiff clay of the Nile valley. The chemical analysis of soil and water testify to their richness.

Beginning at Beled, the delta first consists of bare plains of clay with the silt banks of countless canals, showing what a desperate fight the wretched agriculturists made for existence when the dams were carried away and the level of the water fell. We then have alternate stretches of level country covered with a thorny leguminous plant which dies down in winter, and the same bare plains which we met in the north. Near the rivers are jungles of liquorice plant and the same leguminous thorn. On the rivers themselves, but especially on the Euphrates, wherever there is a foreshore, there is a luxuriant growth of poplars and sometimes of willows. On the upper Euphrates, and as one approaches Babylon, we have great stretches of salted land interspersed with bare plains and low sanddrifts. All this land is capable of easy levelling and reclamation. The presence of 15 per cent. lime in the soil renders reclamation very easy compared with similar work in the dense clays of Egypt. One is never far away from the giant banks of old canals and ruins of ancient towns. As one goes south the salted land increases in area, and then the marshes begin

with their stretches of rice. On the lower Euphrates and on the Basra river are luxuriant date groves and gardens mingled with wheat and clover. The lower Euphrates, past Nasrie and Suk es Shayûk, is a veritable garden surrounded with water.

The junction of the Tigris and Euphrates is no longer at Kurna, where it had been for 500 or 600 years, but at Garmat Ali, near Basra.

Such is Mesopotamia to-day. From what has been already said, it will not be difficult to gather that the first works before the hydraulic engineer are the protection of the country from floods, and the provision of water as free of silt as possible. The levels and surveys of the twelve engineers who are working for me in Baghdad, with a devotion worthy of the task they have undertaken, have shown that we can do both. We have already submitted to the Government a project for escaping the excess waters of the Euphrates down the depressions of the ancient Pison, the first of the four rivers of Genesis. An expenditure of £350,000 should suffice for the work, and it should take three years to carry out. I am under and not over the mark when I say that the cultivated area will be doubled and the yield of wheat trebled along the Euphrates the day this work is completed. The cultivators to-day are afraid to sow anything like the crop they could put in; and, moreover, they count on losing everything every third year. If Noah had been an hydraulic engineer, he would have constructed the Pison river escape instead of an ark, and saved not only his family but his country as well. This escape has been approved of by the Turkish Government, and the necessary funds have been assigned for beginning it immediately. Its effect will be far reaching.

The surveys and levels are now in hand for a project for the great central canal of the delta, which will irrigate 3,000,000 acres of the best land in Mesopotamia, and carry water free of silt. North-west of Baghdad, between the Tigris and the Euphrates, lies a strange depression known as the Akkar Kuf lake. It has an area of 40 square miles at extreme low water, and 300 square miles when full. Its level is 35 feet below that of the Euphrates, and 10 below that of the Tigris. Into this depression runs the Sakhlawia branch of the Euphrates, the ancient Hiddekel, or the third of the rivers of Genesis, with a channel 250 feet wide and 25 feet deep at the head, which splits up into some twenty small channels as it enters the western side of the lake. The head of the Sakhlawia branch will be provided with two powerful regulators to control the supply leaving the Euphrates. On the Euphrates down-stream of the branch will be a barrage to control the river itself. These works will ensure our supply from the side of the Euphrates.

On the Tigris, we propose to construct at Beled, near the site of Nimrod's dam, a weir for controlling the river. This work will be above the Tigris rapids, where the water is 60 feet higher than that of Lake Akkar Kuf. From the upstream side of this weir we shall

construct a canal to irrigate the rich lands north of Baghdad, with an escape into the lake. The escape will keep the canal free of silt, and feed the lake with Tigris water. We shall thus have all the water we need from both rivers, entering the lake at its western and northern sides.

From the south-eastern end of the lake, near Baghdad, will start a canal which will run along the right bank of the Tigris and finally tail into the Hai branch or ancient Tigris near its head. In the days to come, this canal will irrigate 6 million acres, but not now. The excessive silt of some fifteen days per annum, which does all the mischief, will be decanted in the lake, and so will all the silt we do not need. At certain stages of the flood, when the river-water is not heavily charged with silt, it will be possible to take in supplies at different points of the canal. All these details will come later. We are now concerned with broad issues.

The left bank of this canal, which I shall submit to the authorities to be called after the name of the first constitutional sovereign of Turkey, will act as a dyke for protecting the country from the Tigris floods, and will, moreover, carry a railway to transport the abundant harvests of the country. We shall again see Sippara, Kutha, Nil, Niffur, Erech, Tel Senkere, and Tel Lo important centres of life and prosperity.

Dealing with water free of silt, it will not be necessary to complete the whole length of the canal before we can begin sending down our supplies, as we should have had to do with muddy water. We shall first complete some 30 miles, and immediately use the water for irrigation in this reach while we are digging the second reach of 30 miles. In this way we shall waste no time.

The works should, I think, be carried out on the following principles. The Government should undertake the construction and maintenance of the barrages on the rivers, the main feeder canals, the main drains, the navigation works if any, the flood escapes, and the flood embankments. In this way the control of the rivers and their supplies would be in the hands of the authorities. All minor canals, drains, and masonry works of every kind should be left to the agricultural community and to interested parties. In return for constructing and maintaining these works they would receive title-deeds for the lands they irrigated. I had at first thought of recommending the Chenab system of irrigation works, but acquaintance with the people has taught me that all details should be left to the agriculturists themselves. They have their own ideas, and will be far happier working on their own lines, many of which have come down from the remotest antiquity, and are well worthy of preservation.

I have shown how the country can be protected from floods, and how a beginning can be made with the irrigation of 3,000,000 acres of land capable of producing annually 1,000,000 tons of wheat, and 2,000,000

BULL ON THE GATE OF ISTAR AT NEBUCHADNEZZAR'S PALACE AT BABYLON.

cwt. of cotton. It now remains to consider how we are going to get this produce to the markets where it will be sold, and how we are going to dispose of the millions of sheep and hundreds of thousands of cattle which the delta will contain.

Every merchant and man of business I have talked with in Baghdad is convinced of one thing, and that is that the backward state of the country is due in great part to the fact that while communication is open by river with the east, it is to the west that the whole produce of the country wants to find a way. In this direction there is no outlet. The principal products of Mesopotamia to-day—sheep, cows, buffaloes, wool, liquorice, wheat, barley, and rice—have their markets in the Eastern Mediterranean and in Europe, and all the imports the country stands in need of could come most readily from Europe. What is wanted, therefore, is a cheap railway connecting Baghdad with the Mediterranean by the shortest and cheapest line possible. Such a railway would have its outlet on the Mediterranean coast near Tyre and Sidon. These centres of commerce did not place themselves by accident where we find them to-day. They fulfilled the requirements of the trade of Western Asia. Haifa and Beirut, to the immediate south and north of Tyre and Sidon, are the modern representatives of these old Phœnician cities. They are connected by railway with Damascus. Very shortly Tripoli, to the north of Beirut, will be connected by railway with Homs, on the Damascus-Aleppo railway.

Any railway going east from Damascus or Homs must pass through Palmyra, founded by Solomon in Israel's great days, and the capital of Zenobia in later times. From Palmyra will diverge the railways of the future, which will either go north to Thapsacus on the Euphrates, another creation of King Solomon, or to Der Zor of the Khalifs, or eastwards to Abu Kimal near Salahia, a creation of Saladin's. The Damascus-Baghdad railway will pass through Palmyra, Abu-Kimal, Hit, and Baghdad. At Abu Kemal the railway will tap the only part of the upper Euphrates valley capable of great development. In the centre of this tract is situated the rising town of Meyadin, on the site of the ancient Rehoboth. At Hit we have the terminus of free navigation on the Euphrates and the future port of the river. Rivers whose waters are used up in irrigation have their ports where they begin to be navigable.

The Euphrates upstream of Hit, up to El Kaim past Anah, has a narrow valley, but the current is sufficiently strong to turn large water-wheels, which irrigate the country up to the edge of the desert. Upstream of Suk-es-Shayûk this is the only tract on either of the rivers which enjoys perennial irrigation without having to lift the water by means of oxen or pumps. For the area cultivated the population is very dense and the crops excellent. We can here form an idea of what the country will be when perennial irrigation with free flow is available over extensive areas.

From El Kaim near Abu Kimal right up to Meskene opposite Aleppo, the current is incapable of turning water-wheels, and the cultivation is confined to the areas flooded by the river or irrigated by lifting machinery. From Abu Kemal to Der Zor past Meyadin the valley is very broad, and, judging from the ruins of towns and villages, must have been at one time well cultivated. To-day the cultivation is confined to the water's edge. From above Der Zor to Meskene past Rakka, the summer residence of Harun-el-Rashid, the valley contracts and the ground is covered with dense jungle, which supports very many buffaloes, sheep, and camels. Occasionally one meets a patch of rich cultivation, as at Meskene, where an Englishman had erected many water-wheels and was preparing to put up a 20 H.P. engine and pump.

The desert at Hit is flat, and only some 50 to 100 feet above the level of the Euphrates valley. This height gradually increases until at Meskene it is from 300 to 400 feet. For some miles on either side of the valley the desert is broken up into ravines; but as one leaves the river the desert becomes flat, and was described by Xenophon as being level like the sea. The further north one goes the more undulating becomes the desert, but south of Der Zor the undulations are insignificant. Here and there one meets a wady finding its way to the Euphrates valley. Gypsum is the ordinary rock, and there are considerable outcrops of limestone, while immense areas are covered with pebbles, and are known as haswa to the Arabs.

During the winter months the deserts are covered with grass and the hollows are sown with barley. This refers to the country past Hit. The rainfall increases as one goes northwards, and by the time one reaches Meskene the whole country is capable of producing barley with the aid of the rainfall.

The total length of the railway from Damascus to Baghdad will be 550 miles, which could be constructed for £2,200,000. This allows £4000 per mile along an easy alignment, while Nigeria is being developed by railways traversing more difficult country at £3000 per mile. According to the Beduins and the Turkish officers who annually escort the sheep from Abu Kemal to Damascus, water is sufficiently evenly distributed to allow of hundreds of thousands of sheep travelling from the Euphrates delta to Damascus.

In addition to the transport of the exports and imports of the Tigris-Euphrates delta, the railway from Baghdad to Damascus will be the highway for the merchandise of Persia and for all the Moslem pilgrims of Central Asia to the holy cities of Islam. It will carry all the materials and fuel needed for the future irrigation works of the delta, and when continued along the bank of the great central canal to Basra, it will be the shortest route possible between east and west, and will one day be carrying the mails between Europe and India.

Though zealously advocating the direct railway connecting the

Tigris-Euphrates delta with the Mediterranean, as without it the development of the country will not be possible, my hopes are centred in the delta itself, where it is my ambition to see the works carried out which we are planning to-day. I know that in these western countries of Europe, where rainfall is timely and abundant, and where ruin and disaster cannot overtake a country in a day, we are apt to imagine that works of restoration must also take long years to bear any fruit. But in the arid regions of the Earth it is not so. There, the withdrawal of water turns a garden into a desert in a few weeks; its restoration touches the country as with a magician's wand. In her long history of many thousands of years Babylonia has again and again been submerged, but she has always risen with an energy and thoroughness rivalling the very completeness and suddenness of her fall. She has never failed to respond to those who have striven to raise her. Again it seems that the time has come for this land, long wasted with misery, to rise from the very dust and take her place by the side of her ancient rival, the land of Egypt. The works we are proposing are drawn on sure and truthful lines, and the day they are carried out, the two great rivers will hasten to respond, and Babylonia will yet once again see her waste places becoming inhabited, and the desert blossoming like the rose.

The PRESIDENT (before the paper): Sir William Willcocks, who has very kindly undertaken to lecture to us to-night, has had very extensive experience in irrigation works, experience in India, experience in South Africa, and experience in connection with very extensive works in Egypt. He has recently been employed by the Turkish Government (the correct title of his office being Advisor to the Turkish Government), whilst his position may perhaps best be described as that of Director-General of Irrigation in Mesopotamia. Many distinguished civil engineers seem to content themselves, when on business, by merely looking at the country from the point of view of the hydrographical engineer, and with eyes for nothing else. In all the countries he has visited, Sir William Willcocks has always regarded them from the widest possible point of view, and his lecture to-night will deal not only with these interesting questions connected with irrigation, but he will also tell us many things of wide general interest. I will therefore ask Sir William Willcocks to be kind enough to address the meeting.

Sir HANBURY BROWN: I welcome this opportunity of associating myself with Sir William Willcocks and his work in Mesopotamia, even though by no more than speaking after his most interesting lecture. I know nothing about the subject except what I have learned to-night and on previous occasions from Sir William Willcocks himself. But as an irrigation engineer I am able to draw one broad conclusion from what I thus know. From the Lamentations of Jeremiah we may gather that Mesopotamia in olden times was rich and prosperous, by reason of its irrigation works, and that it became "a desolation, dry land, and a desert" when a flood overwhelmed those works. We know also that twenty-five years ago Egypt was languishing by reason of the decay of its irrigation works, on account of the inefficiency of its irrigation service. But what do we see in Egypt to-day? Last year Lord Cromer, at the Society of Arts, spoke of Sir Colin Scott Moncrieff and his

staff of British irrigation engineers as the "saviours of Egypt." Sir William Willcocks was one of that staff, and I feel confident that a man of his energy and determination, fertile in ideas and absolutely enamoured of his work, backed up by the wealth of irrigation experience which he has gained in India and Egypt—I feel confident, I say, that he will earn for British engineers in Mesopotamia the reward of such a compliment as Lord Cromer paid to the workers in a like field in Egypt. The four angels of the Book of Revelation, which were bound in the great river Euphrates, and which were loosed by the angel which had the trumpet, were destroying angels. They have done their work. But the time has come now, let us hope, when the curse shall be no more, and the waters of life of the twin rivers shall be guided through the land to make of Mesopotamia a new earth.

Colonel MAUNSELL: It would be very difficult for me to add anything to the extremely fascinating lecture we have heard, but as one who has travelled four times up the Tigris, I can only testify to the extreme heat of the climate, and the extraordinary difficulty there must have been in carrying out the work Sir William has done. It must have meant the most extraordinary energy and great devotion to duty. As regards new geographical work, he has entirely filled up several blanks on the map; the depression of Habbania and Lake Abu Dibis is quite new, and is not represented on any other maps. That survey is quite a gain to geographical work. Also further down the Euphrates, near its junction with the Shatt-ui-Arab, he has discovered a new channel which the river is forming for itself through the marshes; atlases have hitherto represented the channel going out to Kurna, but that has now become blocked up, and a large lake is forming north-west of Basra.

As regards the railway across the desert from Abu Kemal to Homs, the country is not really a desert; there are numerous wells, and I should think such a line would be perfectly feasible. Having travelled down the Hejaz railway, I think it would be even better than that as regards water-supply. From Homs to Tripoli there is a perfectly easy road at present.

Miss GERTRUDE BELL: All of us whose sympathies are deeply engaged on the side of the new order in Turkey will welcome the possibilities offered by Sir William Willcocks's scheme. It is full of hope. I do not doubt it would bring back into prosperity a great province, and I more than agree with him that with prosperity would come peace and order. I think it was Ibrahim Pasha who said that he who controlled the water-supply of a country controlled the country. That is quite as true of Mesopotamia as it is of the Nile valley. A water-supply firmly and equitably distributed would be a better asset in the hands of the Administration than an army corps. I am an old convert to Sir William Willcocks's railway scheme. His reasons for it are extremely cogent. It will be necessary to bring the stuff he looks forward to producing in such large quantities as directly as possible to the European markets, and impossible to bring it at any reasonable cost by the difficult and expensive route down the Tigris and through the Suez canal. I had hoped, however, that this railway was going to reach the sea, not by Damascus and Sidon, but by Aleppo and Alexandretta. Aleppo is now, and always has been, the centre of the traffic between the inner parts of the Turkish Empire and the sea. It is better suited for that purpose in many ways than Damascus. I know the Germans are proposing to tap the grain-growing region round Aleppo, but at the same time I should have thought that it might have been better to have made some arrangement with them rather than divert an ancient and well-known traffic line. An objection has been urged against Sir William's scheme, and was put forward long before any definite results had been given out to the world by him—notably, by Mr. Frazer in a book he published this spring. It was that the scanty populace of the delta would not afford Sir William sufficient labour for his great enterprises, far less supply the

necessary cultivators to occupy the land which he reclaimed. But it is difficult to over-estimate the mobility of labour in Oriental countries. This points to an economic condition in the Turkish Empire which it is important to bear in mind; everybody is short of a job. I am inclined to believe that the moment Sir William begins his work, he will find labour coming to him in great quantities, and from very distant parts of the Empire. The rumour of a fixed wage will speedily bring people to Mesopotamia, and as the land comes into cultivation, that which is not occupied by the local population will be taken up by these immigrants.

Sir COLIN SCOTT MONCRIEFF: We have had a very interesting lecture on a highly technical subject. I do not think I can say anything on that at a meeting like this. May I be allowed to put a postscript to our President's introduction, and to tell you a little about our lecturer to-night? He has told us about his work, but not about himself. I think perhaps I have known him for more years than any person here, and his life has been a very eventful one. Born and bred in India, he must have been above thirty years old before he ever saw London. He was a very little boy one day in the hot month of May, 1857, when a despatch came to his father from Delhi, only 20 miles off, to say India was ablaze, and the Mutiny was upon us. It was only through extraordinary risks and great danger that he and his party, the father, a very gallant soldier, the gentle wife, and five little boys, managed to escape. It was too much for the mother, but the boys, I am glad to say, are all men now, and have all faithfully served their country; one at the present moment commands the Peshawar Division of the army of India. When I went to Egypt in 1883, Sir William Willcocks was one of the first Indian engineers to join me. He had served under me in India for some years before. I think I may claim him as a pupil of my own, and, as very often happens, the pupil soon surpassed his master. His life in Egypt was full of event. I think I could tell some very good stories of it. For instance, how, walking after dark about midnight from the railway station to his boat on the Nile, he tumbled into an open grave, and when he stumbled out the watchman went at him with a stick, mistaking him for a demon. A remarkable chapter in his life was on one occasion when the Nile flood did not rise quite to the proper height, and a large tract of country in Upper Egypt was left without water flowing over it. There was a canal about 200 feet wide and 20 feet deep, which, if the water could only be held up in it for a few feet and diverted over the land, would do all that was wanted. Willcocks stuck his bed on the bank of the canal, got together the peasantry of the whole province, and for three days and nights worked at it till the water rose and flooded the plain. The people were so delighted with what he had done, that they went to their mosque and insisted that this Christian should go with them and bow down with them and thank God. This is a very unique experience. You can understand from these little traits what Sir William has been doing. He is not the conventional type of man. I am sure that after to-night the allusions we see to him from time to time will all bring to us an interest which we had not before. I have no more to say.

The PRESIDENT: In bringing this discussion to a close, I am sure I can, in the name of every one here present, thank Sir William Willcocks most heartily for his most interesting lecture. I am sure we all feel proud that the Turkish Government has asked a fellow-countryman of ours to direct this beneficent work of converting these arid regions into a Garden of Eden. It is not only thanks we wish to give him; we wish him to know, when he sets out on Friday next on his return journey, that he goes with the earnest good wishes of every one present that his great work will bring forth the full fruit which we confidently anticipate.

Sir WILLIAM WILLCOCKS: I think many people who say that Mesopotamia is a poorly inhabited country all go down the Tigris in the steamers and see nothing. If they would only go down the Euphrates from end to end, they would see that the population is very numerous and very energetic and strong. As to the railway to Aleppo, I do not think, when Miss Bell said that was the ancient route, she was correct. Aleppo is the outlet for everything from Mesopotamia westwards; but from Baghdad westwards Tyre and Sidon have been from ancient times the outlet, and will be again. I think the road to Damascus is the best. I am very much obliged for the kind way in which you have received my paper.

JOURNEYS IN BHUTAN.*

By J. CLAUDE WHITE, C.I.E.

BHUTAN is a country hitherto almost unexplored, and I have been more than usually fortunate in making no less than five distinct journeys through it, and it is of these journeys I propose to give a short account this evening.

The first journey, in 1906, was when I followed the course of the Am-mo-chhu from Chumbi to the plains in connection with the proposed construction of a cart-road. The valley is densely wooded and practically uninhabited, and was interesting mainly on account of its fine vegetation and beautiful scenery. The second journey, also in 1906, was made from Gangtak *viâ* the Natu-la to Chumbi, and then *viâ* Hah, Paro, Tashichojong, and Poonakha to Tongsa and Byagha, on the occasion of the investiture of the Tongsa Penlop with the insignia of the Knight Commander of the Indian Empire. The third journey, in 1907, was along the boundary between Bhutan and British India, from the Jaldakha river to the Gadadhar, and from Doranga to the eastern boundary, and again from Doranga across the Dongma-chhu to Kenga, and a further two days' journey up the Kuru river. In 1907, from Dewangiri through Kheri, Tashijong Tashiyangtsi, across the Dong-la to Lingzi and on to Pangkha, Singi Jong and across the Bod-la to Lhakhang Jong in Tibet. From Lhakhang I followed up the western branch of the Lobrak river to Lhalung monastery, and crossing the watershed entered the Chomo-chang-thang lake basin, and thence to Gyantsi. In 1908, from Chumbi *viâ* Phari to Paro, and on to Poonakha by the route I followed in 1906, in order to attend the installation of Sir Ugyen Wang Chuk as Maharaja, and on my return journey I followed a new route from Paro *viâ* Bite Jong and Dungna Jong to the plains, which I entered at Jaigon.

I will pass at once to my second journey, as that through the

* Read at the Royal Geographical Society, December 8, 1909. Map, p. 104.

Am-mo-chha valley calls for no special notice beyond that the scenery and vegetation were both particularly fine.

Throughout the whole length of the central zone of Bhutan, a well-aligned road runs from west to east, and crosses the ridges separating the various valleys by easy passes from 10,000 to 13,000 feet high, and it was along this road that I travelled in 1906. The road from Gangtok to Rinchingong has often been described, but from Rinchingong, where the old road crosses by a substantial bridge to the left side of the Ammo-chhu, no description has been given. The views down the valley were most beautiful, and the trees very fine. Crossing what was marked as the Lang-marpu-chhu, but is really the Kyunka, by a new bridge, we came to what is known as a cave, or rather two overhanging rocks, which lie in Bhutanese territory. Our old maps are wrong; the true Lang-marpu-chhu is more to the north, while the stream marked by this name is really the Kyunka. At the head of the former stream there is said to be a lake and also favourite ground for the shau, the great Sikkim stag, *Cervus affinis*. A narrow track through woods took us up the Kyunka, to our camp at Lhare, a somewhat confined glade close to the stream. Above this, as we ascended the Kyunka, the road improved greatly and the country opened out, though we were twice obliged to cross the stream by strong bridges.

On the other side of the Chalu-chhu (one of the tributaries of the Kyunka) the valley widened out into most delightful glades and upland swards, forming rich grazing-grounds. Here grew in graceful abundance spruce, larch, silver fir, holly oak, various pines and rhododendrons interspersed by grassy meadows, while the view down the main valley had the appearance of a gigantic avenue, leading up to the snowy pyramid of Gipmochi. Out of this a somewhat steep ascent round a grassy knoll leads to the Dongma-chhu, up which runs another track to the head of the Lang-marpu-chhu, and thus by a northerly but difficult path to the Hah road. The main route leads across the Lungri Sampa up a steep and stony way to Tak-phu, a somewhat bare and extensive flat, well within sight of the Kyu-la. Timber was plentiful, and our camp was further protected by the walls of two parallel moraines; the valley, indeed, was full of lateral moraines, forming gigantic spur works to keep the modern river within bounds. At the same time, so far from these moraines being barren stony walls, they were luxuriantly covered by virgin forest right up to the top of the parent ridge. Snow fell, and in our camp, 13,400 feet above sea-level, we passed a very cold night, there being 18° of frost.

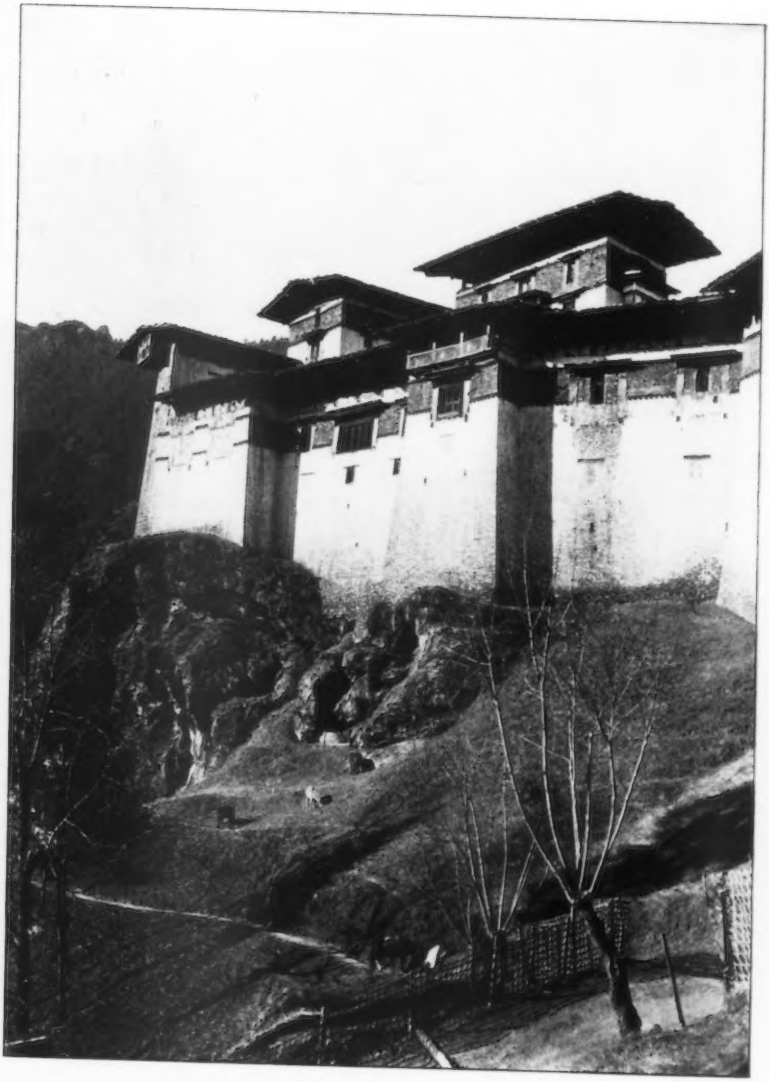
Passing through an extensive amphitheatre, bare and devoid of tarns, the Kyu-la, or rather the long ridge which forms part of the pass, was soon reached; but we had to proceed nearly half a mile along it before we could descend into the wilder amphitheatre of rock and snowfields which lies between the Kyu-la and the Hah-la (or Meru-la

of our maps). This half-basin forms a veritable death-trap in bad weather, as there is neither fuel nor shelter to be found anywhere within its horns. The view from the Hah-la is magnificent; a particular feature in the panorama being a grand but unknown snowy ridge, which ends abruptly on the south-west in a tremendous precipice, where the Am-mo-chhu probably finds an outlet towards the plains.

On the east we looked down a well-wooded but somewhat deep and narrow valley, and through this we descended by a very rough steep track, which, however, improved greatly when a small open glade was reached. The road here turned slightly to the south, down the main valley. It is impossible to describe the beauty of the scenery: grassy glades, gently sloping, opened on a succession of broad valleys in the far distance; on either side, and at our back, was a deep fringe of fine trees of every age, from the patriarch of the forest to tiny seedlings. From the time we left Rinchingong, we had passed through forests without exception self-reproducing, thus showing that the Bhutanese understood the secret of combining in their forests self-reproduction and unrestricted grazing. A good road brings the traveller into the main valley, which greatly resembled an Alpine scene, of magnificent description, with a temple or a monastery on every commanding promontory. Ke-chuka, the first large village we came to in Bhutan, contained a fine sample of a Chuten or cube of prayer, its rectangular form marking a strong contrast to the cylinders of Sikkim and Tibet, while two flour-mills worked by water bore testimony to the prosperity of the villagers. At Kyengsa a road leads up a side valley direct to Duggye jong, which guards the road from Paro to Phari. Yangthang is a large long village situated on the left bank of the river, but numberless irrigation channels have tempted the Hah-chu to forsake its natural bed, and much stony barren land is the result. The formation of the hills is markedly of crystalline limestone, and there are several mineral springs to be met with. The large village of Tumphiong, the chief station of the district, possessed twin forts of no particular strength or beauty; the houses have once been large and prosperous, but are now in a decayed condition. There are curious holes in the limestone formation on the left bank of the river, which seem to connect the river with some subterranean lake; the villagers place baskets at these outlets, and the rush of water at times brings out a number of fair-sized fish, though none are to be seen in the Hah stream itself. The Hah monastery is situate some way up a side valley and commands a magnificent view; it is in good order, but the Poisoners' Chapel, mentioned by Eden, was neglected, and appeared of little interest.

Our route was over a very good bridle path, rideable the whole way to the Chiu-li-la; but the weather, unfortunately, was very damp and misty, and we obtained only occasional glimpses down the Hah valley,

DUGGYE JONG.



DUGGYE JONG.

which runs fairly straight as far as Do-ri-kha, where Eden camped, and whose route in 1864 we were now supposed to be following. High up on the right was the nunnery of Kyila, built on the face of a very steep precipice, most difficult of approach. No male creature is allowed to remain within the precincts of the establishment, and it is said to contain sixty nuns; but as there were more than twenty-five houses, the majority quite large ones, this estimate of the inhabitants seems much too low. Cha-na-na, a small hamlet of some half-dozen houses in a ruinous state, was our halting-place. Our experience in crossing the Chia-li-la was so different in every respect from Eden's that I cannot but suspect that he was deliberately misled from the proper path on to some mere cattle track.

A little below Cha-na-na the path emerges on a well-wooded spur, with a grand outlook over the courses of the Pa-chhu and its affluents, running through a broad, well-cultivated tract of country which could under good management grow every description of temperate crops. On a distant mountain the monastery of Danka-la has been built in such a conspicuous position that it can be seen even from Poonakka; while Beila Jong, which we subsequently passed on our way from Paro, was visible eastwards. To the north lay Dug-gye-jong, dominating the main road to Phari, and deriving its name from a notable victory over the Tibetans; while at Gorina was the monastery which a former Shabdung Rimpoche used to make his summer retreat. Owing to the more favourable climate and country, the monasteries of Bhutan, unlike those in Tibet, are not confined to one huge building or close cluster of dwellings, but consist of houses scattered over the slopes of the hills, each one surrounded by a pretty garden. The chapel at Gorina was bright, clean, and decorated in good taste; while the frontal hangings, overlaid with an exquisite lacework of brass, were superior to anything to be seen in Lhasa. The chuten was a very fine one, having on one of its faces a large brass plate, with a Buddha deeply embossed thereon.

On the ridge below we were received with a salute fired from iron tubes bound or covered all over with leather, which are probably the leather cannons of which we heard so much in the Chinese Goorkha wars. The Paro Penlow's band and richly caparisoned mules were in attendance. Down to Paro the road passes over a deep red clayey slope, impassable in really wet weather.

What struck me most during the last march was the total absence of rhododendrons, and the change from gneiss first to crystalline limestone, sandstone, and dark shales; then to heavy red clay deeply impregnated with iron; and finally to a blueish-grey limestone.

The fort has been built on a limestone bluff overhanging the river; there is only one entrance from the hillside, and this the third story; the lower stories are only partially existent, as their walls seem in great

part to be a mere casing to the solid rock. A heavy bridge over the fosse separating the fort from the rest of the hill leads to a huge gateway, and within this a sharp turn to the left opens upon the eastern courtyard containing the smaller of the two citadels or towers, which is occupied by petty officials. Against the inside of the south and north outer walls are built a series of rooms and verandahs; on the west front directly above the river there is a covered verandah, one story only, from which the balista or catapult, which is still stored there, was worked. The Penlow's quarters are on the first floor in the south-east corner. The reception-room was large, airy, finely decorated, and its walls hung with arms of every description. The opposite corner of the enclosure has a larger suite of apartments reserved for the Deb Raja and other distinguished guests. On the first floor of the main citadel is the public temple or chapel, a very finely proportioned hall with two tiers of well-lighted galleries. All the decorations were good, a hanging lattice of open brasswork being specially effective. In the west corner of the main courtyard was the private chapel of the Ta-thsang or state monks, whose head lama Kun-zang accompanied the British Mission to Lhasa.

Three of the outlying forts, Tazo-jong, Donam-jong, and Suri jong, are existent, though in bad repair, but the very large one of Chubyak-jong is entirely in ruins. Dug-gye-jong is situated some 9 miles up the broad valley of the Pa-chhu, described by Turner "as a fortress built upon the crown of a low rocky hill, which it entirely occupies, conforming itself to the shape of the summit, the slope all round beginning from the foundation of the walls. The approach to the only entrance is defended by three round towers, placed between the castle and the foot of the hill, and connected by a double wall, so that safe communication between them is preserved, even in times of the greatest peril. Around each of these towers, near the top, a broad ledge projects, the edges of which are fortified by a mud wall, with loopholes adapted to the use of bows and arrows, or of muskets. On the north of the castle are two round towers that command the road from Tibet. On the east side the rock is rough and steep; and close under the walls on the west is a large reservoir.

The castle itself is a very substantial stone building with high walls, but so irregular in its figure, that it is evident no other design was followed in its construction than to cover all the level space upon the top of the hill on which it stands. The gateway at the foot of the walls which crown the hill opens upon a flight of a dozen steps, within a narrow passage leading to a semicircular platform, edged with a strong wall pierced with loopholes. A turn to the right leads through a second gateway and along a wide lane, with stables for horses on each side; and a third gateway opens into the interior of the fortress, which forms a large square, with its angles occupied by three suites of rooms.

In the centre of the courtyard is a square citadel several stories high, and containing temples or chapels. The whole place was very clean. The armoury is said to be the most complete in the country, and is contained in a fine room, with a large bow-window facing south, and affording one of the prettiest views in Bhutan. The inner court contained piles of large pine shingles, intended for the repairs of the castle roofs, which have to be done every five years.

The road running from Paro eastwards is very rough and steep up to the Tazo-jong, the curious rounded fort described by Eden as a building formed of two semicircles, one large and the other small, built up one against the other for about five stories high. So far the regular road had evidently not been repaired for many years, but farther on it was good and ascended very gradually to the pass near Beila-jong (8900 feet). On the other side a less gradual descent leads to Pemithang, the seat of a small official, or Penlow.

From Pemithang there are two routes to Tashi-cho-jong—a direct one across the hills *viâ* Pame-la, the other down the Pemi-chhu, and so round by the Tchin-chhu; we chose the latter. The road was good, and the valley thickly wooded and full of flowering pear and peach trees; but on turning eastward up the Tchin-chhu the whole aspect of the country changed to barren hills with sparse and stunted trees. Our camp was at Chali-maphe, not far from the fort of Simtoka. Here was the gigantic cypress, which Eden records as measuring six spans round in 1864. We found it to be 50 feet round the trunk at 3 feet from the ground.

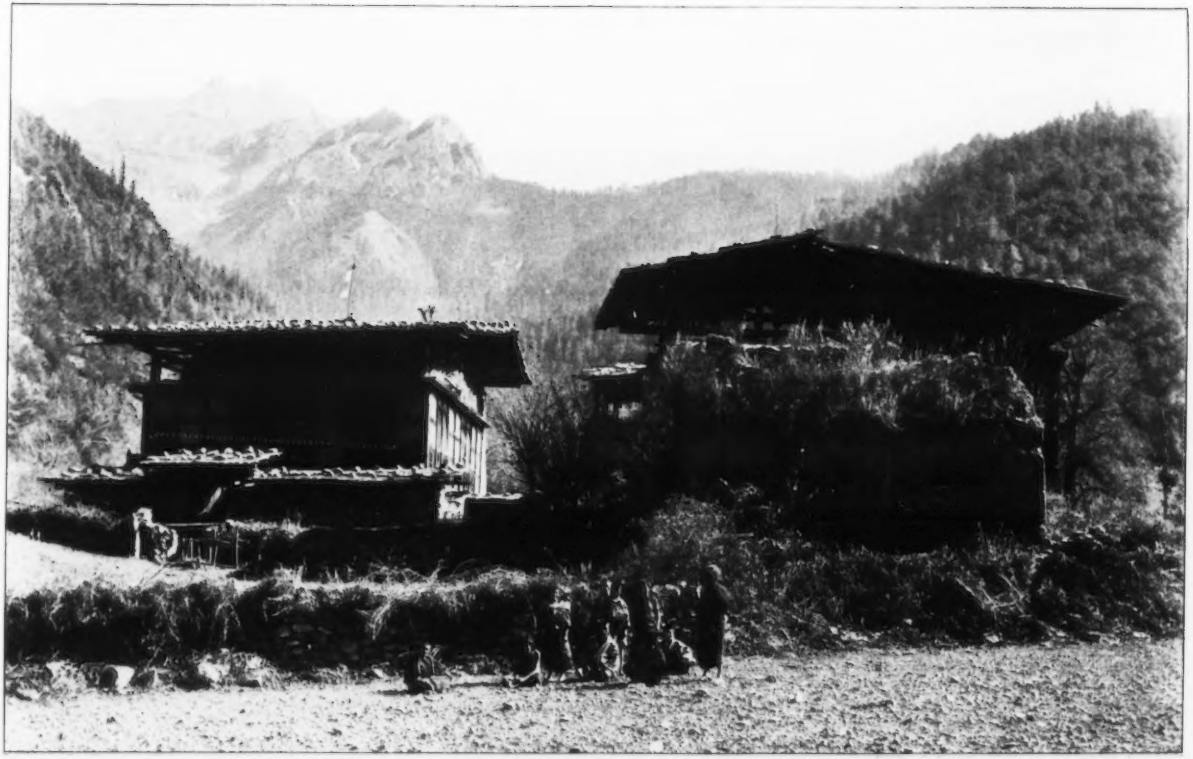
Tashi-cho-jong, the summer capital of Bhutan, lies to the north, up the broad valley of the Tchin-chhu, but as our destination was Poonakha, the winter capital, we took the road leading up the Lhung-tso valley. A short distance above the junction of the two streams, Simtoka fort occupies a projecting ridge, separated by deep gullies from the main hill. The present fort was built by Shabdung Rimpochi in 1873, as the first one, completed in 1870, had been treacherously seized and burnt by his enemies; a scorched pillar belonging to the original building, now almost hidden by elaborate carving, is still pointed out as an object of reverence. In the chapel is the finest statue of Buddha to be seen in Bhutan. It is placed under a magnificently carved canopy, and supported on either side by a number of standing figures more than life-size. Round the plinth of the central tower runs, not a row of prayer-wheels, as is usually the case, but a number of square slabs of dark slate, carved in low relief, with pictures of saints and holy men.

The road up the valley to the Dok-yong-la is a very good one, running through beautiful glades of oaks, willows, chestnuts, and rhododendrons, while on the higher slopes forests of *Pinus excelsa* reappeared, in pleasant contrast to the barren hills of our previous march. On the east of the Dok-yong la we entered a valley, which, in the dampness of

its climate, was suggestive of Sikkim rather than of Bhutan; the path to our camp at Lungme-tsa-we and on to the Teo-pa-rong was steep and slippery, and only redeemed by the beauty of a species of rhododendrons and huge pear-trees. From our camp at Jon-chung-dorong, the mission, headed by a picturesque procession of musicians, dancers, gunners, gaily caparisoned mules, etc., started on April 20, with the intention of making a triumphal entry into the capital of Bhutan, in spite of the difficulties caused by the heavy rainfall and the clayey road. The mission remained at Poonakha until May 2, to enable me to carry out the duties for which I had been sent. The Durbar, at which the Insignia were presented to Sir Ugyen Wank-chuk, was most interesting, but a description of the ceremony would be out of place in a geographical lecture.

The castle of Poonakha looks best from a distance, occupying as it does the whole narrow promontory between the Pa-chu and Ma-chu immediately above their junction. It has the usual towers and court-yards, and was built by the first Shabdung in 1577, and designed to hold six hundred monks: their number has increased since then, and the body ecclesiastic now occupy the whole of the southern third of the building. The two rivers are spanned by fine cantilever bridges of the same style as that at Paro. The earthquake of 1897 was felt here very severely, and the destruction then wrought has not been wholly repaired.

The Ta-lo and Norbugang monasteries are situated high up on the mountain to the west. The track, if it deserves even this name, must be absolutely impracticable during rain, as it runs entirely through clay. As far as Norbugang, about two hours journey up, the hillside was bare and uninteresting, but afterwards the path improved and ran through several pretty glades, where the pear and clematis blossoms were beautiful. After three hours of hard climbing, the monastic colony of Ta-lo was reached: small, well built, two-storied houses, with projecting verandahs and painted fronts, were scattered all over the hillside, each in its little garden of flowers and trees, with here and there a chapel or a picturesque chozten, to break anything like a monotony of houses. The great temple above stood sharply out against a sombre background of cypress and pine: while higher up the small but beautiful retreat of the late Dharma Raja formed a fitting crown to the whole group of buildings. In the great temple were many chapels kept scrupulously clean with, strange to say, glass window-panes. The principal objects of interest were the two large choztens containing the ashes of two of the Shabdung Rimpoche's: they were of silver, highly chased and jewelled, the stones being mostly turquoise of large size but little value. The ceremonial implements used by the late Dharma Raja were fine examples of the best Bhutanese metalwork. The carving of the pillars and canopies was excellent, but so much overladen by open metal scrolls that it was difficult to follow in detail. There was a



FARM HOUSES, PARO VALLEY.

TASHI-CHO-JONG: THE SUMMER RESIDENCE OF THE BHUTAN GOVERNMENT.

magnificent collection (both here and at Norbugang) of banners of embroidery and applique work, and before one of the altars an elephant's tusk measuring 8½ feet.

About 2½ miles up the Mo-chhu above Poonakha are the ruins of a small fort called Sona-ga-sa, mentioned by Turner under the name Zemri-gatchi, and formerly containing the great printing establishment of Bhutan and a fine garden house for the Deb Raja. It was totally destroyed by fire about eighty years ago during one of the many local civil wars, and all the records unfortunately lost, and only a few flowering plants remain to represent the garden. Not far off is a sort of cave or arched recess, which has been formed by percolations of lime bonding together the pebbles of a bank, and in which, nearly three hundred years ago, Nagi-rinchen, a saint from India, is said to have lived. The river here is full of fish, and the resort of many cormorants and gulls. The road up its course into Tibet divides above into two branches, guarded respectively by the forts of Ling-zi and Ghassa. It is rumoured that gold has been found on the mountain ridge between the Mochu and Pacho.

The Bhutanese Government removes from Poonakha to Tashi-chojong at the end of April, so after finishing my work I left Poonakha on May 2, in order to visit Sir Ugyen Wong-chuk's seats at Tongsa and Byagha in the east. The road to Angduphodang is on the left bank of the river and close above it, and the descent is very gradual, not more than 25 feet in a mile, through a valley which is well cultivated, and once must have been thickly populated. The abutments of at least two chain suspension bridges not only betoken much former traffic, but also show how long these mountain streams keep to one channel, for no alteration appears to have taken place since Turner's visit to Angduphodang 130 years ago; and yet there are no sufficiently solid rocks nor guiding spur works to restrain the current. When in full flood the river looks very fine. Turner's picture of the bridge and fort holds good up to the present time. The channel which brings water to the upper fort is nearly 6 miles long, and clearly demonstrates the skill of the Bhutanese in irrigation works. The road eastwards runs just below this channel until it joins the Ba-chu near Chapakha. Up to this point the scenery was poor, and the road hot and narrow, but, on crossing the Ba-chhu, a stiff climb brought us to Satengong, a very picturesque flat overlooking both the Ba-chhu and Tang-chhu, and distinguished by a clump of pine trees, a small lake, and beautiful flowers.

The road eastwards was most excellent, and rendered interesting by the constantly changing scenery on the isolated island hill between the neighbouring rivers. The ascent continued gradual up to Tsha-za-la, and then an equally gentle descent led to a curious deeply cut ravine, where the main range begins. The Tang-chhu is crossed at the village of Ra-tso-wok, a name which betokens its Indian origin, and a good and

very pretty path is lost at Ridha in a fine open space with plenty of flat ground, above which the village houses are clustered on a knoll. There were fine views up to the snowy range whence the Tang-chhu takes its rise to traverse many miles of a rich valley. The march hither was one of the most beautiful which we made during the tour, for the rhododendrons were in flower, and the oaks, chestnuts, and walnuts, with their young foliage, made delightful colouring in the scene. In every direction there was evidence of better cultivation and more prosperity than in any valley we had traversed. Unfortunately, the inhabitants are said to be very quarrelsome, and constant litigation (which means heavy bribes to the officials called in to decide their cases) has tended to keep the villagers more impoverished than they ought to be. Judging from our experience of the Pele-la, both in going and returning, the main ridge here must be the focus of a wet zone, extending as far as Tongsa, damp being drawn up from the plains through the narrow gorges of the Madu-chu: certainly we had worse weather here than anywhere else in Bhutan. The road, though well aligned, paved in many soft places and corduroyed in others, was, owing to the wet clay, very difficult to traverse. The country on both sides was a succession of wide open glades affording excellent grazing stations, and timber was abundant.

On the eastern side of the Pele-la were several large villages at Rokubi and Chandenbi. Not far from the latter place is a charming patch of sward covered with beautiful cedar pines, and situated in a gorge of the ravine, where the Siche-chhu is joined by another mountain torrent. On this tongue of land thus formed were two mendongs (walls of prayer) and a fine chorten, a copy of the Swayambunath in Nepal. From this spot the road ran at the same altitude through oak, magnolia, and rhododendrons for some miles before emerging at Tashiling on more open country, which continued as far as Tshang-kha, high above the raging torrent of the Madu-chhu. Here we camped. Beyond Tshang-kha the road almost immediately enters very rough country, the gorge through which the river flows narrowing considerably, and being flanked on either side of stupendous precipices. As it descends the road becomes a series of steep zigzags, mostly made up of stone steps, and this kind of path continued to within a short distance of the cantilever bridge, which crosses the Madu-chhu some 900 feet below the castle of Tongsa. Another steep zigzag with many flights of stone steps leads up to a small door in an outlying bastion of the walls of the castle, which blocks the way and overhangs the cliff up which the road runs. Passing through a large stone-flagged courtyard, the traveller emerges through another gateway to the east on a narrow path above a second ravine. It will thus be seen that Tongsa castle completely covers a ridge between two steep ravines, and effectually bars all progress from east and west. We camped for a couple of days on a pretty knoll, which, being clothed in

fine trees and provided with an excellent stream of water, running over cascades into a fish-pond, is the pleasaunce of the Tongsa monks. The fort consists of several courts, but suffered from the great earthquake, and the eastern citadel had not been completely restored at the time of my visit. A women's choir formed part of the procession sent to play us into the castle—a curious performance which is mentioned in Pemberton's report.

A steep ascent leads to the outlying fort, which commands the castle itself. A good and easy road runs onwards over the Yo-to-la and down to Gya-tsa, the Faisa of Griffiths, who notes that it is "a good-sized village, comparatively clean, and with houses which were, he thought, better than most he had seen." The country through which we marched had again changed from a system of narrow gorges into a series of broad valleys, the upper ones grazed over by hundreds of yaks, the lower rich with barley, buckwheat and mustard fields. Dotted in their midst were erected temporary huts to shelter the cultivators during their stay in these higher elevations at the time of ploughing, sowing, and reaping, while down in the valley more substantial permanent dwellings proved that the district was better governed and more prosperous than any other we had seen. An easy road leads over a saddle on the Ki-ki-la and down into the valley of Chamka-chhu, where at different elevations are the castle of Byagha in the middle, Sir Ugyen's private house above, and his sister's below at Angducholing. Dr. Griffiths wrote, "The country was very beautiful, particularly in the higher elevations, but we saw scarcely any villages and but very little cultivation." Within the last thirty years this state of things has been remedied, and under the present more stable government conditions have greatly improved. The fort of Byagha was totally destroyed in the great earthquake, and has been rebuilt on a smaller scale—a remark that also applies to the residences of Sir Ugyen and his sister.

The route to Lhasa past Kulha Kangri lies up the valley of the Pumthang, and in a subsequent journey my baggage had to go by this route, as the direct route from Tashiyangtsi up the Lobrak was not passable. The site of the Sindhur Raja's palace is shown 2 miles above Angducholing. This prince was converted to Buddhism by Padma Jungne early in the eighth century of our era; the saint's resting-place is held sacred, and the depression in the rock, where he leant against it, has been roofed in and made into a gorgeous shrine.

On our return journey to Simtoka the scenery appeared even more lovely owing to the immense number of flowers in bloom—three kinds of yellow roses, clematis, wild pear, and rhododendrons were in wild profusion, while the meadows were literally carpeted with blue-and-white anemones, yellow pansies, and countless primulas. The giant Sikkim primula was in magnificent bloom, some plants having as many as six tiers of flowers. Each day brought out new kinds—a large

white rose, a white and a mauve iris, and the giant white lily appeared for the first time. Orchids were abundant, and it seems a pity that the *Cypripedium Tibeticum* does not figure more in our shows, as the flowers we gathered were, as a rule, larger and finer than that figured in 'The Orchids of the Sikkim Himalaya.'

At Simtoka we crossed the Lhung-tso and proceeded up the broad valley of Thimbu-chhu or Tchin-chhu to Tashi-cho-jong, passing *en route* the knoll of Changlingmethang, where, in May, 1885, the then Poonakha Jongpen was killed, Aloo Dorzi defeated, and the supremacy of Ugyen Wangchuk's party so firmly consolidated, that there has been no revolution or internecine strife in Bhutan for the past twenty-four years.

Unlike other Jongs, the present Tashi-cho-jong has been built on the plain; it differs also from other forts in having two large gateways and in being protected on the west and north by a wide fosse filled with water. The bridge across the Tchin-chhu is not connected with the castle, as at Paro and Poonakha. The interior is arranged in a succession of courtyards, as in other castles; the northern portion being set apart for the monks. The main tower was destroyed by the earthquake; the new one was carelessly built on the old and shaken foundations, and already shows signs of serious subsidence. The original castle stood on a spur about a mile away near Dichen-Phodang; but having been damaged by fire, Deb Jidhur, at the end of the eighteenth century, removed the materials to the present site and rebuilt them there. We found the Deb Raja and his court comfortably established for the summer, having completed their annual migration from Poonakha.

After taking formal leave of our hosts, we marched north up the Tchin-chu valley, which for some 3 or 4 miles was open and well cultivated. Turning over a steep bluff, we entered an entirely different country as the valley narrowed considerably, and, being beautifully wooded, was picturesque to a degree. Our destination was Chari, the first monastery founded by the great Shabdung Rimpoche; it is terribly difficult of access, being perched on overhanging rocks, so that to get from the lower to the higher chapel it is necessary to climb up very narrow, rough stone steps, squeeze round the corner of a precipice, and descend other steps to the platform of the temple, which is literally clinging to the cliff. No wonder the Shabdung's enemies attacked it in vain. We now entered the narrow gorge that leads from the middle zone to the upland pastures. At first there was no road along the stream, but our path took us high up the hillside, where we had to round cliff after cliff, all well wooded, until we slightly descended to a small open side valley, in which the fort of Barshong is situated. From this place for some 10 miles the road was close to the stream, which had to be crossed and recrossed about six times before it emerged

POONAKHA: WINTER RESIDENCE OF THE BHUTAN GOVERNMENT.

VILLAGE OF NORBU-GANG.

on to the open uplands below Byaradingka. The gorge was almost filled by the Tchin-chhu, and bordered by stupendous cliffs of most weird shapes. These cliffs appeared to be formed of horizontal strata of sedimentary rocks, consisting of layers of limestone, sandstone, slate, or shale of a dark blue colour, and quartzites, and were cleft in many places from top to bottom, thus leaving narrow slits or fissures, often more than a mile long.

From Byaradingka an hour's gradual ascent led to the Yakleh-la, whence the road descends somewhat sharply to the Pimnakme-chhu, a stream which joins the Mo-chhu below the fortress of Ghassa. A few miles down the valley, Lingzi-jong suddenly appears in sight on a hill that seemingly blocks the valley; we had, however, to round several ridges before reaching our camp some way below the Jong. The fort was totally destroyed by the earthquake, and has not been rebuilt. The road rounds several ridges before making the final ascent to the Phew-la ridge, which separates Bhutan from Tibet. At Gangyul, a little village on the Tsango-chhu, the view of the Chumolhari glaciers is magnificent. A fair bridle-path leads along the left bank of the Tsango-chhu to a small but flourishing side valley, blocked at one end by a gneiss cliff, extending from side to side in a perfect level, over which poured a very fine waterfall. This little valley was well cultivated, and possessed many large juniper trees. The path brought us at an easy gradient to the top of the cliff, which we then discovered was the lower edge of another long level valley. In this way we progressed by a succession of steps, until we came to the last tread of the stairway, which was an almost precipitous slope of stones and rocks, up which our yaks and mules struggled slowly but surely, the zigzag, as far as alignment went, being very good. Above this was a small roundish flat, in the centre of which were the walls, still good, of the fort built by the Tibetans during our late troubles. A short incline leads to the pass, 16,400 feet, whence is obtained a magnificent view of the plains and hills of lower Tibet. The contrast between the fertility of Bhutan and the barrenness of Tibet is startling.

On my third journey along the boundary of Bhutan I traversed a great part of the outer range of hills, and was enabled to judge of the suitability of this ground for Nepalese settlers, of whom large numbers were entering the country, and also of the extent of the forests as well as the amount of damage said to be done by the cultivation of the outer and very wet slopes causing landslips, and consequently raising the river-beds in the plains, and, by altering the old courses, making them overflow the lands on either bank.

These extensive landslips are certainly taking place, and causing very considerable damage to low-lying tea-gardens, but the cause is not cultivation, but the excessive rainfall, which is literally washing away these hills, composed as they are of very soft strata, much shattered and

faulted. The worst damage was being caused in most places in the valleys which did not run far into the hills, and in which there were no settlers or cultivation. I also found much excellent land suitable for the cultivation of tea, which would benefit the Bhutan Government to a very large extent were they to allow European capital into the country for the purpose. There are magnificent forests also in this part of Bhutan, but the difficulty of transport would prevent their ever being a source of revenue to the State. I also found a considerable amount of coal in the lower hills, but it was of an indifferent quality and very much crushed.

From Dorunga I travelled with Sir Ugyen, and we went a short way up the Kuru river. Our first day's march took us through a very narrow gorge with perpendicular quartzite rocks on either side, and a hard climb brought us to the top of the pass, where we stayed for the night. The next day we dropped down into the valley, and after two days' march, came to the Dongma-chhu. It is difficult to judge of the relative size of the two rivers, the Dongma and Kuru, without scientific observation, but I am inclined to think that this branch of the Monass, the Dongma, is as large, if not larger, than the Kuru or Lobrak. I saw both rivers on this journey in the cold weather, when the water was at its lowest, and I again saw them on my fourth journey, in the rains, when they were very much swollen, and I was therefore able to judge fairly well. After crossing the Dongma-chhu, the surrounding rocks changed to manganese limestone, and the vegetation lost all its sub-tropical luxuriance, and was chiefly *Pinus longifolium*, of which there were some magnificent forests. On the outer slopes of the hills there is hardly a habitation, but on coming into the Kuru Dongma-chhu river-basin villages became more plentiful, and there was a considerable amount of cultivation. The houses were well built, and the people looked prosperous and contented. My return journey was made by a slightly different route, which brought me out at Dewangiri.

I started on my fourth journey in May, 1907, in the middle of the hot weather, and until I reached Dewangiri the heat was excessive. The track leading from the plains to Dewangiri passes through narrow ravines in the sandstone hills, and a sudden thunderstorm coming on, I was nearly washed away with my baggage. The river rose with extraordinary rapidity. On leaving Dewangiri I followed Pemberton's route *viâ* Tashigong to Naylamdang opposite Lhuntsi Jong, but from thence I turned to the north, following up a tributary of the Kuru river. I was unable to follow the Kuru itself owing to the lateness of the season, for the river was already in flood and had washed away all the temporary bridges thrown across it to make a cold-weather road along its banks.

My route took me past Singhi Jong and over the Bod-la into Tibet. The road is fair all the way to Singhi Jong, and I was able to ride

most of it; but soon after leaving Singhi I had to abandon my mules and walk, and transfer my baggage to coolies, as the track crosses some magnificent but almost impassable rocks. The views near the pass were fine, but the weather was very wet for the most part, though in crossing the pass I left the rain behind me and had magnificent weather. The scenery also changed, becoming more rugged and barren, though some of the slopes were still well wooded. On descending the valley I soon realized I had entered Tibet, as the mountains opposite on the other side of the eastern branch of the Lobrak had not a tree or, to all appearance, a blade of grass on them, owing to the monsoon current having been stopped by the southern watershed of the great Himalayan range. I camped at Lhakhang Jong, where the Tibetan officials did all in their power to make me comfortable, and where Sir Ugyen met me. From Lhakhang my journey took me entirely through Tibet, and hence does not come within the scope of this paper, and I will only add that I went as far as the head of the Lobrak Chhu, crossed into the Chomo-Chang-tang lake-basin, and thence into the Neylung valley and on to Gyantsi, from whence I returned by the ordinary route *viâ* Kala Tsho and Phari.

My fifth journey took me practically over the same ground as in my second journey, with the exception that on this occasion I entered Bhutan from Phari *viâ* the Temola, following the route *viâ* Duggye Jong, and returned to the plains from Paro by a hitherto unknown route *viâ* Bite Jong and Dongma Jong, entering the plains at Jaigaon. This journey calls for no special mention, and as my paper is already a very lengthy one, I will pass it over with the remark that on the journey from Paro southwards I passed some magnificent forests of pine of all kinds, and on the outer slopes of fine oaks and chestnuts, which ought in the near future to be of value to the Bhutan Government, and which I have advised them to conserve most carefully, as they are within carrying distance of the large tea districts in the Doars and the prospective tea industry along the Bhutan subhills, where there are most valuable tea lands, regarding which the Bhutan Government is at present negotiating with the British Government.

I hope I have said enough to show what an exceedingly interesting and beautiful country Bhutan is, and hope that under Sir Ugyen's rule it will soon be opened up and become a prosperous and enlightened State.

Geographical Position.—Bhutan is bounded on the south by Assam, on the east by the state of Towang, subject to Tibet, on the north by Tibet, and on the west by Sikkim and the British district of Darjeeling. It lies entirely within the Himalayas, between 26° 30′ and 28° 30′ N. lat. and 88° 45′ and 92° 15′ E. long.

Mountain System.—The mountain system may be most easily described as a series of parallel ranges running, in a more or less southerly

direction, from the main ridge of the Himalayas, where they attain an altitude of from 24,000 feet to 25,000 feet.

River System.—The drainage runs from north to south, following the mountain system. The main rivers are—

(1) The Ammo-chhu, known as the Torsa in the plains, which takes its rise in the western slopes of Chomolhari, and drains the Chumbi valley.

(2) The Wang-chhu or Tchin-chhu, known as the Raydak in the plains; its main tributaries are the Ha-chhu and Par-chhu, as well as many small rivers.

(3) The Mo-chhu or Poonakha-chhu, which becomes the Gadadhar in the plains. Its main tributaries are the Tang-chhu, Po-chhu, and Mo-chhu, and it drains a very large area, some of its tributaries taking their rise on the south side of the Wagya-la, at the head of the Neylung valley.

(4) The Karu-chhu or Lobrak-chhu, known in the plains as the Monass. This river, as well as its large tributary the Gongmachhu, takes its rise in Tibet on the northern slopes of Kulu Kangri, and in a snow range to the east of Towang. It has several other large tributaries, amongst them the Pumthang-chhu and the Mati-chhu. The Monass drains the whole of eastern Bhutan, and has cut a deep gorge from its source to its inlet in the plains, passing through the main range at an elevation of 10,000 feet.

General Division of Country.—Bhutan may be roughly described as consisting of three distinct zones rising one above another.

1. The outer hills, which rise abruptly from the plains of Bengal to a height of between 3000 to 4000 feet.

2. The central temperate valleys, running up to a height of 9000 feet.

3. The high grazing-lands and snowy ranges.

1. The first zone is about 30 to 40 miles wide, where the rivers run with great swiftness through deep-cut ravines. The rainfall varies from moderate to excessive, and the vegetation is luxuriant. Owing to the prevalence of fever, habitations are few and far between, tenanted principally by Bhutanese bearing a bad character, and by Paharias, who have migrated from Nepal along the foothills. The climate is indifferent, but on the uplands of Sipchu in the west the Nepalese emigrants have cleared off the forests and are increasing rapidly, in a manner which shows that in their case they find nothing to complain of.

2. The central zone covers from 20 to 25 miles, and is a series of wide valleys parallel to each other, running in the same direction as the mountains. The slopes are not nearly so precipitous as in the outer hills, and, owing to a more moderate rainfall and cooler climate, are clothed with the vegetation of more temperate regions, such as firs, pines, junipers, oaks, etc. These valleys lie at elevations from 4000 feet to 9000 feet, and are sometimes over 2 miles wide, as at Paro and

Byagha. In my opinion, these flats appear to be beds of old moraines which have not yet been scoured out into the deep-cut V-shaped valleys which characterize the lower hills. The rivers, owing to their broader channels and diminished rainfall, are not so swift or so subject to floods, and in consequence the range of fluctuation in their levels does not exceed a few feet.

3. The third or northern and highest zone consists for the most part of narrow gorges opening out into wider valleys, hemmed in by high bare rugged mountains, and as the greater part of it lies above the limit of tree vegetation, it is but sparsely inhabited.

During the summer months, when the higher slopes are covered with luxuriant grass, a limited number of families, with their herds, which are not very numerous, consisting mostly of yaks, migrate to these uplands to take advantage of the splendid grazing. Sheep are conspicuous by their comparative rarity, but game is plentiful, Burhel, *Ovis Hodgsoni*, shau, and takin being found in these parts.

Climate and its Effect on Vegetation and Scenery.—Lying in the position it does, and with such differences in altitude, naturally the climate of Bhutan varies enormously, and with it the vegetation, which graduates from sub-tropical in the deep-cut lower valleys to arctic in the higher regions. Consequently the scenery is very varied and most beautiful. In the lower valleys, with the excessive rainfall and the hot moist atmosphere, the vegetation is luxuriant, palms, ferns, canes, and bamboos growing in wild profusion, changing gradually as one ascends to groves of chestnuts, oaks, alder, fir, magnolia, and birch, the highest of all birch and juniper, close to the snow-line. Between 4000 feet and 15,000 feet, the whole of the higher hills are clothed with most beautiful rhododendrons, of which there are no less than thirty-three known varieties, and which, flowering in masses, make a blaze of colour, while the magnolia blossoms stand out pure white and pink on the huge trees in the midst of dense forest. In the forests themselves, above 7000 feet and up to 10,000 feet, the trees are festooned with trailing masses of moss and grey lichen often 4 feet to 6 feet in length, and have every appearance of a fairy scene, more especially when after rain everything sparkles with dew-drops in the brilliant sunshine. At these high elevations, too, are the enormous pine forests into which the glaciers descend, and still higher, stretches of magnificent grazing-grounds studded with alpine flowers, surrounded by some of the finest snow-peaks in the world.

Every kind of scenery is to be found, from the lower valleys with masses of tropical vegetation growing in the soft damp atmosphere, full of brilliant soft colouring, with their great swift rivers running past, and glimpses of the distant snows, to the higher valleys and mountains with more temperate vegetation, their forests, and craigs, with mountain torrents rushing through narrow gorges and wonderful waterfalls, and

wider views of the snowy mountains, still with the peculiar softness due to the damp atmosphere; and, highest of all, magnificent snow-peaks and glaciers standing out sharp against the sky or shrouded in cloud and mist, grim and forbidding. It is impossible to find words to express the beauty of the scenery and its varied character, and I fear my lantern views do but bare justice to their subjects.

History.—To explain some terms in my lecture a very brief history of Bhutan seems necessary. In the eighth century of our era the country was inhabited by people closely connected with India, and governed by small princes, of whom the Sindu Raja was the most powerful. This monarch, with his subjects, was converted to Buddhism by the Indian Saint Padma Sambhava some time prior to the saint's visit to Lhasa. The kingdom, however, was overthrown in the latter part of the ninth century by Lan-darma, the apostate King of Tibet; and again two centuries later the country was overrun by people from the north of the Himalayas; but no one appears to have had any authority, until we find in the thirteenth century a powerful lama, styled Lapha, who in his turn was ousted by Lama Fago Dukgom-Shig-po of Ralong, with whom came five lamas belonging to rival sects. I mention this, because Lama Apha, after his defeat, handed over the Chumbi valley, hitherto Bhutanese, to the ruler of Tibet. In 1557 A.D., another Ralong monk, Dujom Dorji, entered Bhutan, and after continuous warring with the successors of the five lamas mentioned before, made himself master of the whole country; several invasions from Tibet were successfully repulsed, and his kingdom firmly established. He is best known by his title of Shab-dung Nawang-Namgyel-Rimpoche, or the Dharma Raja of Bhutan. He introduced good government, appointed local governors under the titles of Penlops, Jongpens, Zimpens, etc., and established a central council, with a deputy or Deb Raja as president, and to them entrusted the executive or civil administration, while he devoted the latter days of his life to religious duty. He died in 1592, aged fifty-eight.

After his death a triple reincarnation arose. His body reappeared as the Dharma Raja, his voice as the Chole Tulku, and his mind as Thi Rimpoche; and these incarnations have been continuous to the present time. The late Dharma Raja died some four years ago, and his successor has not yet been recognized, the late Deb Raja was the Chole Tulku, while the Thi Rimpoche has committed grievous sin and will not again appear.

The office of Deb Raja was an elective one, and lasted nearly 350 years; but on December 17, 1907, the lamas, officials, and laymen of Bhutan unanimously abolished the office, and proclaimed Sir Ugyen Wangchuk Maharaja or Gyelpo, and declared the office to be hereditary in his family. This was done with the consent and approval of the Deb Raja, who has now retired to a life of seclusion and religious meditation.

BRIDGE AT ANGDUPHODANG

TONGSA JONG.

The proximity of Bhutan to the route finally adopted for our military expedition to Lhasa in 1904 rendered the attitude of the Bhutanese Government toward us a matter of considerable importance. Fortunately, the Durbar decided to follow the precedent of 1888, and refused to join Tibet. They moreover sent the Tongsa Penlop, Ugyen Wangchuk, as their representative to accompany the mission, to give every assistance in his power. As a recognition of his valuable services, Ugyen Wangchuk was honoured by a Knight Commandership of the Indian Empire, and in March, 1905, I was despatched by the Government of India, at the head of a mission, to convey to Sir Ugyen the Insignia of the Order.

Our knowledge of Bhutan has been chiefly derived from the somewhat restricted reports of previous missions. Bogle in 1774, and Turner in 1783, entered the country from the plains of India at Buxa, Captain Pemberton with Dr. Griffiths at Dewangiri, while Eden crossed from Darjeeling *viâ* Dumsong and Sipchu in 1864. There was also the military expedition in 1864–5, which resulted in our seizure of the eighteen Docars and the Daling Subdivision territory, which has proved of enormous value to the Government of India, and which brings in a large revenue.

Ethnography.—It would be impossible to classify or trace the origin of the many different types of people found in Bhutan, without long and careful study, but I would point out that people from China, Ladakh, and Europe have found their way to Bhutan, as well as Khampas, Duphlas, and other nearer races. We came across two or three men who, in fairness and texture of skin and hair and in feature, were indistinguishable from English or Germans, while others were low animal-looking negroids; but among the better classes there certainly are three distinct types: first, one in which the men, like Sir Ugyen Wangchuk, have broad pleasing faces, somewhat French in character; second, a Semitic type, with features resembling those of Cabulis; and a third type, in which the facial characteristics are oval and refined.

A curious fact differentiates the Bhutanese from all their neighbours, viz. the hair on their faces. It may be noticed that the Dharma Raja is usually depicted with a long pointed beard, and many, like Sir Ugyen, wear moustaches.

Morals.—It is possible that eighteen years' freedom from internecine strife, and a firmer and juster administration, as well as a complete cessation of slavery, when the slaves were recruited from the scum of the plains, may have brought about a change in the moral qualities of the Bhutanese; but my experience in no way bears out Dr. Griffith's strictures that they were "immoral, indecent, dirty, wanting in courage, and given to drink; while the higher classes were utter strangers to truth, greedy beggars, rapacious, and crafty in working evil." I will not finish his remarks, as they are utterly inapplicable at the present

time. On the contrary, we were well received and welcomed everywhere. Nothing immoral or indecent ever came to the notice of myself or the members of my missions either time, or in any of my travels. The men are not nearly so dirty or offensive as they have been represented, nor do I consider them idle and drunken. Certainly they do drink much *chang*, but not so much as their Sikkim neighbours. Besides, the strength of *chang*, or *murwa*, is less than half of the mildest of ales, and it is impossible for even a weak-headed person to become at all elevated by drinking it.

On the outer hills bad characters undoubtedly swarm, and so acquire a bad reputation for the bulk of the people; but in so far as personal experience goes, I can hardly speak too highly or gratefully of the friendly reception I met with everywhere, the warmth of their welcome, and the desire of all classes to show me hospitality.

Physically, the Bhutanese are a fine, robust people, who compare very favourably with their neighbours in Sikkim, Tibet, and the plains. They are active and capable of enduring hardships; good walkers, and able to cover immense distances in their own hills. On the other hand, the Bhutanese are rather wanting in energy and initiative, and at the same time are inclined to bluster. Those who live in the intense cold of the higher altitudes, in tiny huts full of smoke, are dirty in person and habits; but we ourselves did not always insist on having a morning tub when at 13,000 feet. All the people who formed the immediate *entourage* of the officials were clean and respectable in their outward appearance, while the officials themselves were always immaculate in their brocades and silks.

It is impossible to estimate the population of Bhutan exactly, or even to decide whether the true Bhutanese race is diminishing; but there can be no question that the outer hills are being overwhelmed by a flood of Nepalese immigrants. The general appearance of the country, the evidences of the abandonment of houses and terraced fields, and the decay of irrigation channels, all show that there were more cultivators formerly, and that there is ample scope for regeneration and immigration. I can safely predict that a little assistance and encouragement from the Government of India, which has benefited so much by the annexation of the Bhutanese Duars, would secure a return of prosperity throughout the country, which at present probably includes a population of at least 300,000.

Religion.—The religion professed by the people of Bhutan is Buddhism or Lamaism, *i.e.* they follow the religion of Lhasa, and though they have their own particular saints, they look up to the Delai Lama as the head of their Church.

Industries.—In handicrafts the Bhutanese used to be exceedingly clever, but the increasing poverty of the state is producing its natural effect, and good workmen are becoming very scarce. Good specimens of

metalwork are still made for the monasteries, but the open work, so conspicuous on the older sword-handles and dagger-sheaths, has almost become a lost art, and the same may be said of the work in applique and embroidery. Casting of bells and other articles is still carried on at Paro and Tongsa and other large forts. Weaving is pretty general; the factories are maintained by the wealthier officials, and the weaving-room at Byagha was very noticeable. Cotton, wool, wild and domestic silk are all freely used, but, unfortunately, the introduction of aniline dyes has spoilt many patterns. Matwork is very good, the work in many of their baskets being so fine as to be watertight.

Sword-blades are much valued, and good ones are regarded as heir-looms, and handed down from father to son. These blades, by dint of continual heating in charcoal, have been made into excellent mild steel, and are kept beautifully bright and polished. Their price varies from £2 to £50, though to a casual observer one is just as good as another.

Wood-carving and painting are still in demand for the monasteries, and, though scarcer than formerly, show no signs of deterioration. Clay images and ordinary articles of domestic use are turned out, but the potter's art is at a low ebb.

As architects and builders, the Bhutanese are no mean workmen. The houses are either built of stone set in clay, or clay empese. Under the latter process, clay mixed with small stones is placed in a wooden frame or mould and trodden down until it is consolidated into a block; this, on exposure to air, quickly hardens, and in course of some years acquires nearly the solidity of stone. This preparation is used either in blocks made on the ground and employed like huge bricks, or in layers made on the actual wall. The outer side of the walls has a slight inward slope, but the inner side is perpendicular. The houses consist of three or four stories, with generally a balcony or two, and sliding shutters to let in light or keep out cold. No ironwork is used, the doors turning on wooden pivots. The frames, beams, etc., are all fitted together on the ground, before being set up in the building itself, and kept together with key-pegs. Timber being plentiful, the ceilings are supported on numerous heavy beams, and are well planked, the highest being always covered with a coating of pounded clay to help keep rain out. The roofs are gently inclined, and formed of pine shingles from 4 to 5 feet long, which are kept in place by heavy stones, as in Switzerland. There are no chimneys, and ladders take the place of staircases. In laying out buildings, set-squares and a skirret and line are used. Wedges and heat are employed in splitting the stone slabs (many of which are of great size) used in paving the courtyards.

The cantilever bridges are very strongly made, and some are as much as 170 feet in span. The chains for suspension bridges are made of wrought-iron links, but of late years the construction of this kind of bridge seems to have been abandoned, whilst previously existing ones

have been allowed to rust and decay. I did not notice any cane suspension bridges such as are common in Sikkim.

Geology.—I regret to say I know very little of geology, but, speaking generally, the extreme outhills are formed of soft sandstone, which contains veins or strata of coal. This series is the same as the Damuda series, and the coal is of the same formation. Where I have seen the coal, it is much crushed, has often been forced up by enormous pressure into lintel-shaped pockets, and is usually much faulted, and in many places inverted. The sandstone does not extend the whole way along the foothills, and has in several places been denuded.

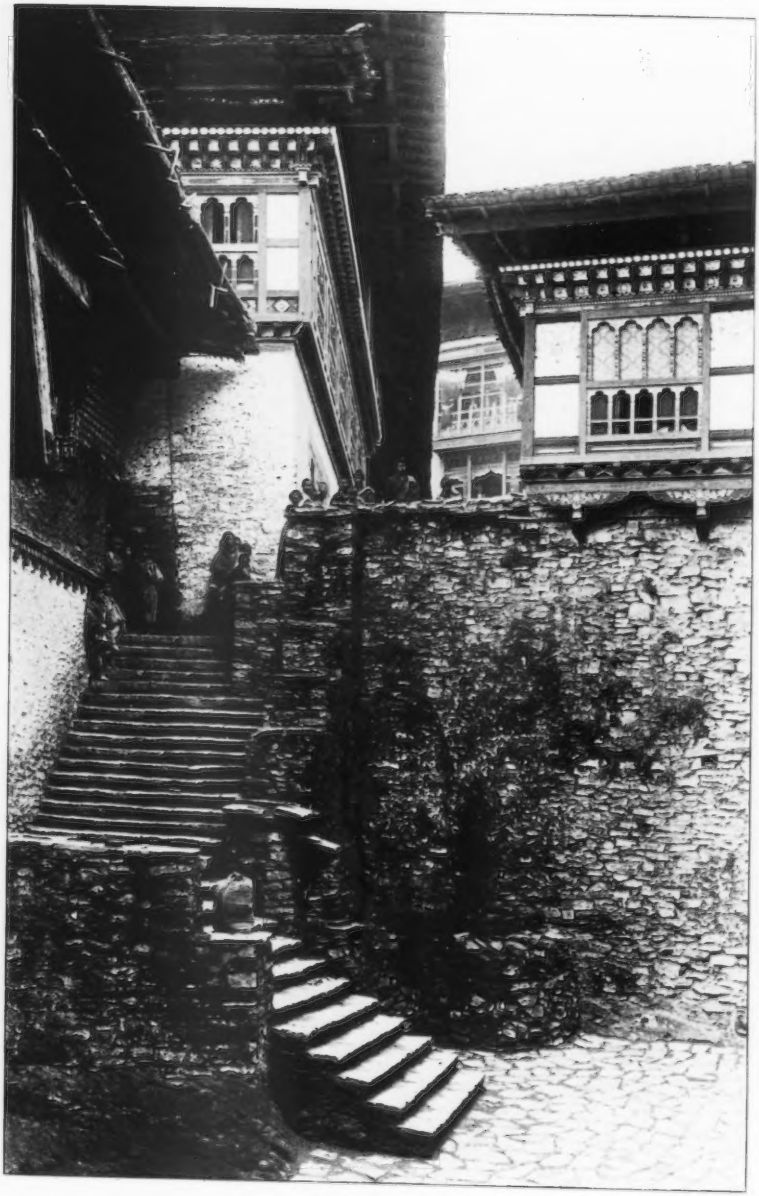
Above these come mica-schists and quartzites. It is in the former that most of the minerals are found, but with the exception of copper, none have been found of any value. Iron is found in places, and is still worked by the Bhutanese. Above the quartzite magnesian limestone appears in several places, such as the Kuru river at Kenga, on the road to Tongsa from Dewangiri, and at Buxa. Above them comes gneiss, which forms the bulk of the rocks right up to the snows. This, however, is not invariable, as thick beds of limestone and shale are met with—limestone up the Tchinchhu, at Poonakha, Rokhbi, and in the Chumbi valley; and shale in the Tchinchhu and Chumbi valleys. Some of the very highest peaks are composed of granite, as the horn of Chumulhari. Beyond, *i.e.* to the north of the very highest peaks, come shale and limestone containing fossils. This tract is, however, in Tibet. A piece of gypsum was found in the river-bed close to the Dung-ma-chu.

Botany.—We had a professional plant-collector with us, who succeeded in finding some 150 or 160 new species; the collection has not yet been systematically examined, so I cannot give any definite information as to the net result. This, however, is of little consequence in view of the magnificent collection made by Dr. Griffiths; and I can add nothing to Dr. Anderson's short note of 1865.

Zoology.—As regards animals, the habitat of the Takin (*Budorcas taxicolor Whitei*) was ascertained. Also news of several herds of shau does in the Chumbi valley was brought in, but none of stags, so they were left severely alone. Burhel were plentiful; in north-east Bhutan, *Ovis Hodgsoni* was common. Elephants were numerous in the outer hills, but most of the tusks we saw were said to have been obtained from elephants that had been dead for years. In the Tongsa Jurisdiction quail were very plentiful.

Among their domestic animals, the cross between the hill cattle and the wild mythun (*Bos frontalis*) is a very fine animal; the plough oxen in the Pumthang valley would earn a high place at our agricultural shows. So highly valued is this breed, that the Nepalese Government constantly send over to Bhutan for pure and half-bred mythun; a yearling calf which was offered to me was said to be worth at least £20 on the spot.

VALLEY ABOVE PASHI-CHO-JONG.



INTERIOR, TONGSA JONG.

Pigs also are good, English and China stock having been imported. Many of the fowls were fine birds, and pigeons swarm everywhere.

The once celebrated Tangun pony, mentioned by Turner and others, had entirely disappeared some twenty or more years ago; a mysterious disease broke out and swept the stock away. Mr. Paul seemed to have possessed one of the last; it was a very powerful skew-bald about 13 hands high at the outside, with a silky coat remarkable in a hill pony. At present the ponies are not equal to the mules, but Sir Ugyen has now imported an Australian stallion. The best mules, however, are brought from Tibet. Altogether horse-breeding is at a low ebb, as railways and cart-roads have put an end to the trade in ponies with the plains.

Revenue.—The second Deb Raja Migyur Tempa made a very good cadastral survey and record of rights, which is the basis of the present revenue system. The rent rolls are issued under the seal of the Deb Raja, and counter-sealed by the local Penlop or Jongpen. The position, size, and nature of each man's holding is carefully entered, and all increases or decreases, and any change of ownership, are noted under seal; the ryots only pay for what they actually possess; in consequence the state revenues vary, and are declining. The old village boundaries are still retained, and consist of natural features, such as rivers, streams, and ridges.

Agriculture.—Griffiths records, "Of the agriculture of Bhutan little is to be said, as so very large a proportion of the supplies is derived from the plains. The stage in which the little agriculture that is carried on is, argues as little in favour of the amount of agricultural skill they possess as the uncultivated state of the Duars does in favour of the numerical extent of their plains subjects." Probably the loss of these Duars has compelled the Bhutanese to pay more attention to agriculture. The Bhutanese cultivator lays out his fields in a series of really beautiful terraces, levelled from the side of the hill and often supported by strong revetments of stone, sometimes of considerable height. The fields are usually carefully protected either by stone walls or by fences of young pine trees and pine staves. In the main valleys further protection to the crops is afforded by planting rows of willows and other trees across the general direction of the violent winds which rush up from the plains.

To the excellence of their irrigation works I have already borne testimony. Both hoe and plough are used; the latter being larger and stronger than that of the plains. The principal crops are rice, wheat, barley, maize, buckwheat, turnips, and peas; as well as mustard and castor-oil seed and sugar-cane in small quantities. Oranges of excellent quality are grown on the outer hills, and very good walnuts are indigenous. Madder and rubber are not properly cultivated, but are found wild. Paper of very tough quality is made from the daphne plant,

which also grows wild. No attempt has been made to grow mulberry plants, because the cocoons, from which Endi or Erhi or Tussar silk is made, are collected in their wild state from the jungles inhabited by the insects which produce them.

The PRESIDENT (before the paper): Mr. White, who has kindly consented to lecture here to-night, is an engineer by profession, and, in the course of his professional duties, he has visited a great many parts of India. During the last twenty years he has been chiefly employed in Sikkim and in connection with the Tibetan border, and he has thus had the opportunity of making a number of interesting journeys into Bhutan, a region which is very little known. It is the results of those journeys which he is kindly going to describe to us to-night.

After the paper, Sir JAMES BOURDILLON: I was not aware that any discussion would take place, but I should like to say a few words which occur to me with reference to Mr. White's lecture. I wish first to draw attention to a matter which would certainly never have been mentioned by Mr. White himself, and that is the great debt we all owe to his untiring endeavours, and to his personal qualifications for carrying out the expedition he has described. He was stationed for a long time in the Eastern Himalayas, and gradually acquired a unique influence and authority among the people of those regions. Thus has grown up gradually, and by almost imperceptible degrees, the great power he displayed in carrying through this expedition. Bhutan, for a long time, has been an absolutely closed country to Europeans, and, if we look back to our official relations with that country, the review is one which cannot be regarded with satisfaction. Our envoys have been insulted, and our efforts towards friendship have been frustrated again and again; so that it is a most remarkable achievement on Mr. White's part that he has been able to carry out this expedition, and to turn what was a hostile foreign state into a neighbour closely allied in friendship with the Government of India. Mr. White has not been able, in the short time placed at his disposal this evening, to say much about the manufactures and the beautiful artistic work accomplished by the people. The Bhutanese have long enjoyed a very remarkable civilization. The metal work, the weaving, the embroidery, are all of the highest character, and not only very beautiful, but possessed of very distinct characteristics of their own. In conclusion, I will only ask you to express your satisfaction with the lecture we have heard to-night, and in doing so, never to forget how much is due to the great personal influence of Mr. White himself.

General Sir RONALD MACDONALD: My first acquaintance with Mr. White was just at the start of the Tibet Expedition. I had then the feeling that trusting to a single line was perhaps rather hazardous, and I asked Mr. White whether he could run an alternative line from Sikkim. He at once undertook to do so, and, thanks to his influence in Sikkim, he was able to put on something like 1500 men, who worked all through the winter and assisted our advance. When we got into the Chumbi valley in the winter, we very soon found that Mr. White had a great reputation among the Bhutanese, and when the Tongsa penlop, who is now the Maharajah Bhutan, came to visit us, he was already predisposed in Mr. White's favour; but this rapidly ripened into confidence and friendship, which has enabled Mr. White to achieve the great results of which we have just heard. We have heard how Mr. White was a welcome and honoured visitor in the exclusive country of Bhutan, and I will mention one little incident at Lhasa. When we arrived there, the Tibetan representatives asked us that we should prevent any of our officers or men entering any of their sacred places. After consulting Colonel Younghusband

I issued orders that all monasteries and temples were to be out of bounds. Then a message came in from the monasteries and chief Llamas to say that Mr. White was expressly excluded from this restriction, as he was welcome to visit their monasteries at any time, and they would be glad to see with him any officers for whom he vouched. While Younghusband and I were debarred from visiting any of these places, Mr. White was welcome.

Mr. A. W. PAUL: I may be permitted to add a few words to Mr. White's lecture, as I accompanied him in one of his journeys, and I would emphasize in particular the kindly way in which we were treated. I had some slight acquaintance with the Bhutanese before, because they were always having revolutions, and the unsuccessful always came to me, but even I did not realize their true worth When I went under Mr. White's auspices, I was practically a cripple. They understood that, and I was met by all sorts of contrivances to get me through without trouble. On the last pass I had two yaks, because they said the yaks were not in very good condition owing to the severe winter, and might get tired and jerk me; I had three mules—the very best, and, what was more than all this, five stalwart men. Mr. White only told you half the truth when he said that for dignity's sake he rode up from the river to the Tongsar fort. I can only tell you that not even his cook was able to ride down to the river. When I started I did not know what I was going to do, but I found my five men waiting for me, and they got me over that awful place in comparative comfort; it did not matter in the least bit where I was, I always had somebody to help me. I can only join with Mr. White in thanking them sincerely for all the kindness they have shown us. I quite endorse every word that has been said about Mr. White's influence and about the necessity of knowing more about Bhutan. The difficulty, even in recent years, of getting into touch with Bhutan and learning the true position of affairs there, was a cause both of anxiety and danger. Even as late as February, 1874, Mr. (Sir John) Edgar, then Deputy Commissioner of Darjeeling, wrote to me, "I have been thinking about that Bhutan business, and do not like it. I do not see clearly any danger on our side, but still one ought to make sure. Make private inquiries, but mind there is no fuss, for of course very little would make a panic, which of all things is to be avoided." It was essential to do everything possible to prevent a panic taking place amongst the coolies on the all-important tea districts lying at the foot of the Bhutanese hills.

It was a work of constant and unceasing anxiety to get into closer relations with Bhutan, all the more difficult because Government did not give us a free hand. But now Mr. White has changed all this, and the Bhutanese officials, so far from resenting interference, voluntarily petitioned Government to grant Mr. White extension of service that he might continue to help them.

Since Bhutan is so near the wealthy plains covered with tea gardens, it is absolutely necessary for the Government to encourage Mr. White's successor to continue amicable and sympathetic feeling and intercourse with the people of Bhutan, so that we may be confident that nothing will disturb the progress of the great tea industry. I am sure you will join in thanking Mr. White for having opened up a country which was described once as "hardly worthy of much consideration."

The PRESIDENT: In bringing the discussion to a close after the extremely interesting paper which Mr. White has been kind enough to read to us, I am speaking in the name of everybody here present when I say that the photographs have been ones of exceptional interest and exceptional beauty. I am very glad to hear what has been said by the various authorities here present of Mr. White's admirable work in Bhutan, and I am sure he deserves the greatest credit for what he has done in creating a spirit of friendship between the people of Bhutan and the

people of England. Mr. White tells me that he was able on one or two occasions to do a certain amount of surveying. It is often impossible for the head of an expedition to spend very much time in surveying operations, and I cannot help feeling it is a pity that the Government of India does not send a trained surveyor with all such expeditions. If this had been done we should now know far more about the detailed geography of Bhutan. The Government and people of this country are very apt to cry out for the want of maps. But if such steps were taken in advance, then the information would be at hand when wanted. I have merely to add that we always have an exhibition of objects of interest from the country about which the paper deals, and that on this occasion it is one of exceptional interest.

THE DEVELOPMENT OF WHEAT CULTURE IN NORTH AMERICA.*

By ALBERT PERRY BRIGHAM.

In the year 1602, on one of the Elizabeth islands off the present coast of Massachusetts, Bartholomew Gosnold made trial plantings of wheat and other grains. The Spaniards had earlier brought wheat to Mexico, but this was probably the first wheat sown within the boundaries of the United States. Nearly twenty years later wheat was sown at Plymouth, without success the first season, but with returns afterward. The grain extended itself among the New England colonies, and about 1700 there are records of shipments, as from Norwalk to Boston and Boston to Virginia. As the eighteenth century progressed, however, wheat declined, except as sown on fresh clearings, and was brought in from New York and the southern colonies. That wheat was already moving westward is shown by the fact that New England traders bought New York wheat, ground it in their own mills, and sold it in the West Indies. To revive wheat culture, Massachusetts laid a duty on the product to be paid as a bounty to farmers, but Weeden tersely says that "the duty could not counteract climate and soil nor feed the fishermen."

There is early record of wheat in Virginia, for in 1607 the Council informed the Council in England that they had fortified themselves against Indians and had "sown good store of wheat." The first sowings of English seed at Jamestown seem not to have been very successful. By 1800 wheat was raised along the entire Atlantic border except the southern parts of the coastal plain, but the middle states from New York to Virginia assumed pre-eminence and held the centre of wheat for more than a generation. Meantime, in 1769, missionaries carried the grain to California. There was important export to the West Indies in the early years of the Federal government, until Great Britain shut out the ships of the United States from this trade. In 1787 wheat was among American exports to Mauritius. But it was long before the United States was to assume a commanding position as a purveyor of bread, for in the decade 1830–1840 she imported several million bushels of wheat to feed her own population.

In the later years of the eighteenth century and the first decades of the nineteenth, western New York, or the Genesee country, proved its suitability in soil and climate for the growing of winter wheat. On the completion of the Erie canal in 1825, the industry was favoured by increased prices; the region was the famous wheat centre of the country, and Rochester was relatively as important for primary market

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* Read at a joint meeting of the Sections of Geography, Agriculture, and Economics, British Association, Winnipeg, August, 1909.

facilities and milling as Minneapolis is to-day. The primacy of western New York was held until wheat began strongly to occupy the states north of the Ohio river.

Before tracing the westward march of the wheat centre it will be useful to survey the expansion of acreage and production during recent decades, or since 1866. It is this period of progress which has more than historical interest, since it has to do with any forecast of the future. From 1866 to 1875 the acreage in the United States varied between 15 and 26 millions, and there was a consistent rise from the beginning to the end of the decade. In the following ten years, to 1885, the range was from 26 to 39 million acres, giving on the whole a steady increase, but showing 34 million acres in 1885. The period 1886–1895 ranged from 34 to 39 million, with smaller acreage in the later years. From 1896 to 1905, the minimum was 34 and the maximum 49 million, but from 1898 to the present time the limits have been 42 and 49 million acres. The highest figure, 49 million acres, has been reached twice, in 1901 and 1903, and the significant element in the figures is the high average of the last dozen years.

Turning to production, the total for 1866 in the United States was 151 million bushels. In the next year, 1867, production passed the 200 million mark permanently. Another milestone was passed in 1873 with 308 millions. In 1878, the crop was 420 millions, and in 1882, 504 millions. There were fluctuations in the following years, for production from 1883 to 1890 only once reached the 500 million mark; but 1891 made a showing of 611 millions, and 1898 brought 675 million bushels. The average from 1898 to 1908 has been 643 million bushels, and the maximum was in 1901, 748 million bushels.

If single states be considered, some curious fluctuations are observable. Thus Kansas has never attained even fourth place in a census year, yet holds the state record, with her crop of 99 million bushels in 1901. She has at least four times passed Minnesota's record of 80 million bushels. Minnesota dropped from 68 millions in 1899 to 51 millions in 1900, and leaped to 80 millions in 1901. North Dakota in the same years went from 51 to 13, and back to 49 million. Kansas in those years made a steady gain from 35 to 82 and 99 millions. Production is so widely distributed, however, that the general total for the country is much more stable.

For an orderly review of the movement of wheat from east to west in the United States four regions may be distinguished as follows: (1) the middle Atlantic States from New York to Virginia, including especially Pennsylvania and Maryland; (2) the five states of the "Old North-west," lying between the Ohio river and the Great lakes; (3) seven states west of the Mississippi river, including Missouri and Kansas on the south and Minnesota and North Dakota on the north, the wheat belt reaching to the arid parts of the Great plains; (4) the Cordilleran region extending to the Pacific coast.

The first of these regions was the North American centre of wheat from the first full establishment of the crop in the colonies until the Erie canal and other means of communication opened to the east the possibilities of the old North-west. The crops of New York for eight census years are as follows. The crop of 1908 is also included :—

1839	12,286,418	bushels.
1849	13,121,498	„
1859	8,681,106	„
1869	9,750,000	„
1879	10,746,000	„
1889	8,929,000	„
1899	7,005,765	„
1908	7,752,000	„

The crop of 1905 rose above 10,000,000 bushels. Pennsylvania has had a fairly steady rise from 13,000,000 bushels in 1839 to 24,000,000 in 1899, and her crop for 1908 was 29,000,000, ranking this state among great producers—a fact not often recognized. Maryland has almost trebled since 1869, and has been above the ten million mark since 1897, producing nearly 15,000,000 bushels in 1907. Virginia fluctuates, usually producing from 6 to 10 million bushels. Even West Virginia, North Carolina, and Georgia show fairly steady records of several million bushels each. Taking those states which border the Atlantic, not including the gulf, the total production of wheat in 1906 was 76 million bushels. In production per square mile Maryland held third place in the census of 1900 and in that of 1890, and her crop per capita in 1907 was more than 11 bushels. New York's production averages about 1 bushel per capita, and Pennsylvania's rate in her best years is about 4 bushels.

These figures concerning the sustained yield of many states on the eastern border have been given to show that the decline in wheat culture in this region is largely relative rather than absolute, a fact with which common impressions are at variance. It is true that as a whole the needs of the local population are not met, and that here is a large market for western wheat, but it is not true that the soils are exhausted, or that the Atlantic belt of states fails, or will ever fail, to make a substantial contribution to the bread supply of the nation. New England's contribution was never of great significance, but it is of interest to note that in recent years Maine and Vermont are the only states in that group which make a report of this cereal.

Before passing to the remaining major regions, it will be of interest to show in the following table the rank of leading states in census years since 1839:—

RANK OF LEADING STATES FROM THE SIXTH TO THE TWELFTH CENSUS.

Year.	First.	Second.	Third.	Fourth.	Production of first state.
1839	Ohio	Pennsylvania	New York	Wyoming	16,000,000 bush.
1849	Pennsylvania	Ohio	New York	Virginia	15,000,000 "
1859	Illinois	Indiana	Wisconsin	Ohio	23,000,000 "
1869	Illinois	Iowa	Ohio	Indiana	30,000,000 "
1879	Illinois	Indiana	Ohio	California	44,000,000 "
1889	Minnesota	California.	Dakota	Indiana	45,000,000 "
1899	Minnesota	N. Dakota	S. Dakota	Ohio	68,000,000 "

The swift progress of wheat westward is well shown in the fact that Illinois, which is not named in 1849, takes first place in 1859. In the same sudden manner Iowa springs to second place in 1869, and Minnesota to first rank in 1889. It will be remarked that Ohio persistently keeps its place within the group of four for every census except one, and that is not the last one. In the same connection it should be observed that a state lying farther west, Illinois, after holding the primacy three times, passes at once out of the leading group. It has already been stated that banner state-yields seem to avoid census years, for Illinois has a record of 60 million bushels in 1880, Minnesota has risen to 78, 79, and 80 millions, North Dakota to 75 and 77 millions, and Kansas leads all, producing in 1901, 99,079,304 bushels.

In 1839, while New York and Pennsylvania stood at 12 and 13 millions, Ohio had come to the front with 16 million bushels, and the great record of the second region was well begun. In forty-one years, from 1866 to 1906, Ohio produced 1,247,082,674 bushels, an average of 30,416,650 bushels. In the twenty-year period, 1867–1886, the total falls more than 100 millions short of the total for the following equal period, 1887–1906. This is a most significant showing, and it should be added that among all states, Ohio in the twelfth census, crop of 1899,

stood first among all states in product per square mile. Thus still further emphasis appears as to the importance of wheat grown east of the Mississippi river. Ohio has eight times exceeded 40,000,000 bushels.

The facts for Indiana are of similar magnitude. In 1860 she was second in production per square mile, was first in 1870, 1880, and 1890, and fourth in 1900. Her total for forty-one years, 1866–1906, fell little short of Ohio, and she raised nearly 100,000,000 more in the second twenty-year period than the first. Like Ohio, Indiana exceeded 40,000,000 eight times in the period named, and raised more than 45,000,000 in 1908. Illinois has a total for forty-one years just under that of Indiana, being 1,160,352,208, an average of 28,301,273 bushels. In this state a balance of about 100,000,000 bushels is in favour of the first twenty-year period. While Ohio and Indiana contain only minor areas of prairie, Illinois is a typical prairie state and goes heavily into the production of maize, in which it more than equals the combined crops of Indiana and Ohio.

Michigan and Wisconsin, the lake states of this group, make a lesser showing in wheat, Michigan having produced in forty-one years two-thirds as much as any one of the three Ohio river states. The second twenty-year period shows a moderate decline over the first. In 1908, however, Michigan raised nearly 16,000,000 bushels, a product of no mean order. Her maximum of 34,000,000 in 1898 suggests what her possibilities are. Wisconsin has a different record, having often produced over 20,000,000 until 1884, and since 1892 has but three times reached 10,000,000. In 1908 she dropped to 3,328,000 bushels. This does not mean that this great state is unsuited to wheat. The crop suffered decadence through soil exhaustion, insect enemies, and the vast growth of dairying; but with intelligent methods there seems to be no reason why Wisconsin may not again stand well up in the wheat column. Mr. R. A. Moore, Agronomist of the College of Agriculture at the University of Wisconsin, expresses the opinion * that "the pendulum will swing back to quite an ex'ent." He thinks the land of Wisconsin too rich for oat-raising, and that with rotation and other modern methods wheat can again be raised without impoverishing the soil. Before leaving the second group of states it will be of interest to note that of the entire crop of 1906, in the United States, or 735,000,000 bushels, 250,000,000 were grown east of the Mississippi river. This amounts to about 34 per cent., or slightly above one-third of the total. The third group of states forms the well-known present centre of wheat in the United States, and the figures need not be given in detail for individual states. Minnesota produced 10,000,000 bushels in 1867, and has steadily risen, until, since 1895, her crop has never been less than 46,000,000 bushels, and has ranged up to 80,000,000. Iowa as a praire state most resembles Illinois, but her wheat has seen larger decline. Thirty years ago the crop often passed 30,000,000 bushels, but in recent years runs from 8 to 14 millions. The reason is doubtless to be found in the expansion of maize and live stock industries. Her average for forty-one years, 1866–1906, was 21,432,000 bushels. Missouri holds a strong average production in recent years, of 20 to 30 million bushels, the maximum being 56,000,000 in 1902.

Kansas, Nebraska, and the two Dakotas may be called the Missouri river wheat states, and represent the newest and greatest development of wheat within the territory of the Republic. In 1882 Dakota territory (before division) reported 11,000,000 bushels. This was but twenty-seven years before the present writing. Since 1897 the crop of North Dakota alone has but once fallen below 51,000,000 bushels, and rose in 1905 and 1906 to 75 and 77 millions. Nebraska's product is usually above 40,000,000 bushels. The total of the three leading wheat states of the present time is as follows for the ten years 1897 to 1906:—

* Letter of March 16, 1909.

Minnesota	685,129,558	bushels
North Dakota	533,777,567	„
Kansas	687,901,805	„
Total	1,906,808,930	„

Kansas has a slight lead over Minnesota. She has had several greater crops than her rival, but is subject to greater fluctuation. The average annual total for these three states 1897–1906 was 190,000,000 bushels. The states of Oklahoma and Texas represent an extension of this belt along the more southern parts of the prairies and great plains. Oklahoma has a record in 1894 of 2 million bushels, with a fluctuating rise to 18 and 15 millions in 1906 and 1908. The crop is, of course, of longer standing in Texas, with report of nearly 2 million bushels in 1866, to a recent average of about 12 millions. It is an important fact that this belt with its wide range of latitude divides itself into a spring wheat region embracing the five states Iowa, Nebraska, Minnesota, and the Dakotas, and a winter wheat section to the southward. In like manner, Wisconsin and Washington, in the second and fourth of our major regions, raise spring wheat.

The Cordilleran region offers an older development of wheat in the three Pacific states, and a more recent progress in the intervening regions of the Rocky mountain plateaus and Great Basin. This is in harmony with the extraordinary leap of the frontier a half-century ago, followed by the gradual occupation of intervening territory.

California reported 12 million bushels so long ago as 1868. Her maximum crop of 45 million bushels belongs to the year 1896. A comparison of two twenty-year periods, 1868–1887 and 1888–1907, shows but slight decline; but if two ten-year periods, 1888–1897 and 1898–1907 be taken, there is an important falling off, due perhaps to the immense advance of horticulture and the progress of irrigation. California produced in thirty-nine years, 1149 million bushels of wheat. Oregon has had a somewhat uniform range of 10 to 16 million bushels since 1880, rising to 24 million in 1898. Not quite 11 million bushels were produced in 1908. Washington, on the other hand, has seen conspicuous progress, and since 1897 has ranged between 20 and 34 million bushels. The greatest thousand-acre yield ever reported is ascribed to eastern Washington in 1881, viz. 51,000 bushels.*

Outside of the coast states there are no large producers in the Cordilleran region. Idaho, Colorado, Utah, and Montana each grow several million bushels per annum, but in a general survey their chief interest has to do with their future possibilities under irrigation. The Cordilleran total for 1906 was 94,111,584 bushels. This is 18 million bushels more than was grown in the Atlantic coast states in the same year, but the western area is several times greater.

The following table, from the Twelfth Census, gives the successive positions of the wheat centre of the United States for the half-century, 1850–1900.

WHEAT CENTRE, U.S. 1850–1900 (SECONDS OMITTED).

Census year.	N. lat.	W. long.	Approximate location by important towns.
1900	41° 39′	94° 59′	70 miles west of Des Moines, Ia.
1890	39° 33′	93° 9′	138 miles south by east of Des Moines (in Mo.).
1880	40° 36′	90° 30′	69 miles north-west of Springfield, Ill.
1870	40° 39′	88° 48′	82 miles north-east of „ „
1860	39° 59′	86° 1′	18 miles north by east of Indianapolis, Ind.
1850	40° 14′	81° 58′	57 miles east-north-east of Columbus, O.

* 'Rep. Bureau of Statistics, Washington, 1903,' p. 69.

An examination of this movement brings out some interesting facts. The amount of westward migration in fifty years was 680 miles. The northward movement was about 99 miles. The latitude variation was marked by slight fluctuations for forty years, and then in a single decade wheat moved more than 2° northward, owing to rapid increase in the north-west. The greatest westward movement was in the first decade, 1850–1860, amounting to more than 200 miles. The westward movement in the ten years 1890–1900 was a little less than 100 miles.

At the last census the centre of population was in south central Indiana; the centre of manufacture was in central Ohio; of corn, in Western Illinois, between Springfield and St. Louiz; of all cereals, on the Mississippi river near Keokuk, Iowa; and the centre of wheat was in Western Iowa. In 1850 the corn and wheat centres were near each other in Ohio. Wheat has outrun all the other great interests in its westward march.

The present position of the centre of wheat raises a most interesting inquiry. The latest data are for 1908, and returns for a few minor states are not before the writer. For exact determination, detailed figures for counties are used by the Census Bureau. But taking the state totals, it appears that 320 million bushels approximately were raised in the states east of the Mississippi, plus the tier of states bordering the west branch of that river. This is a little less than half the crop, and would seem to carry the centre for 1908 out of Iowa and across the Missouri river. Considering latitude movement, it must be noted that California has fallen off, but this is partly offset by a decreased crop also in Oregon. The crops, however, of Kansas, Missouri, Illinois, and Indiana, which are mostly south of the centre of 1899, were much greater, in relation to the total, in 1908 than in 1899. It would seem clear, therefore, that for 1908 the centre has returned southward, and might probably be found in south-eastern Nebraska.

Passing to the inquiry as to the centre of wheat in North America, it is to be observed that the Canadian crop of 1908 * was 112,434,000 bushels.

To take this into account would move the centre as determined for the United States northward, across a belt sufficient to raise half the Canadian product, or 56 million bushels. Assuming the centre for the States as in south-eastern Nebraska in 1908, this belt would cross Southern Iowa, and the northern part of Illinois, Indiana, Ohio, and Pennsylvania. As these states are heavy growers, the belt would be narrow, and the centre for North America would not go higher in latitude than that for the States in 1899.

The greater part of Canadian wheat, about 92 out of 112 million bushels in 1908, is raised in the western provinces, and therefore westward of the centre for the States. Making allowance in a similar manner, the longitude centre for North America would be found by passing westward across a section of Dakotas, Nebraska, Kansas, and Oklahoma, and would probably lie in Nebraska, 100 miles or less westward from Omaha. This is more than 500 miles from the Canadian border, and the Dominion's production must vastly increase before the 49th parallel will be approached.

The importance of the new development in the north is not, however, thus measured. It is easy to conceive of a time in no distant future when the United States might raise 800 million bushels, and consume 700 million, while Canada might at the same time raise 400 million and consume 100 million bushels. The northern country would even then hold a threefold more important place in the public markets of the world than her neighbour, even while the North American centre of production remained at some distance south of the international boundary.

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* *Census and Statistics Monthly.* Ottawa: December, 1908.

The movement of wheat-growing has been from east to west, and will now be from south to north. This is largely the movement of history, and follows the migration of the frontier in our continent. The direction has thus had a historical origin, and both the direction and the rate of movement have been conditioned by the development of transportation. The more special and local reasons for the shifting of wheat lend themselves to inquiry, and have perhaps been nowhere else so well discussed as by Mr. C. W. Thompson.* The subject of study is the shifting of wheat-culture in Minnesota. This cereal has gone from south-east to north-west in the state. Olmstead county, in the south-east, is as fertile and as capable of large crops of wheat as the best Red river lands, and is as good now as it was in 1870. The one region is as favourable in soil and climate and as suited for the use of machinery as the other. But as population increases and land grows in value, more must be allowed for rental, or interest on investment, and intensive, diversified farming replaces the more extensive wheat farming. The bonanza wheat farms tend to break up as the population grows, for with skinning processes, and much hired help in one part of the year, and, it may well be added, with no stock or rotation of crops, there is no way to enrich the land, to cultivate thoroughly, and thus increase the product of an acre. The acre must be put to crops and tillage that will enable it to bear its greater burden, and wheat must go elsewhere. Moreover, the best returns accrue where one man, the owner, and one set of farm machinery, do most of the work. Such farms contain from 160 to 170 acres of land. Hence, not only does diversified farming drive out wheat in some measure, but the smaller wheat farm drives out the great bonanza farm with its thousands of acres, its enormous machines, and its small army of labourers.

It is, therefore, an error to think that wheat must pass or be in jeopardy with the elimination of the frontier. This has already been seen in the sustained wheat-growth of the North-West. In the census year, 1899, more wheat was raised on farms of 101–175 acres than on those of any other specified size. Less than one-eleventh of the country's wheat grew on farms exceeding 1000 acres. Almost one-fifth was raised on farms of less than 100 acres. Taking the whole country, the yield per acre on the smaller farms was slightly greater than the yield on the large farms, notwithstanding the fact that the latter were chiefly areas of virgin soil. Thus, while wheat has figured largely as a pioneer crop, to be grown on free or cheap land, these conditions are not so important as is supposed, and an old, highly cultivated country like France, raising nearly all its own wheat, offers the best of object lessons. Dondlinger,† while holding that much land will become too valuable for wheat, thinks that lands now idle will be brought to its production, and even anticipates that the centre of wheat-growing may reverse its historic direction of movement and return eastward.

In 1904, Dr. William Saunders reported that Fort Simpson on the Mackenzie river was the most northerly point from which samples of wheat had been received. This is about 62° N. lat. Dondlinger‡ is authority for the statement that spring wheat has been matured at Rampart and Dawson, still nearer the Arctic circle. It is fair to say, however, that the latitude range of wheat in North America is from 30°, latitude of New Orleans, 60°, latitude of the northern boundary of Saskatchewan and Alberta, a belt of 30°. The areas of large and assured production may, however, always remain between 35° and 55°, with more chance for northern than

* *Quart. Journal of Econ.*, vol. **18**, 1904, p. 570.

† 'Book of Wheat,' p. 303.

‡ *Ibid.*, p. 5.

southern expansion. In Eurasia, wheat reaches to Trondjhem (63½°) and northern Russia, and to a point in India below the Tropic of Cancer (21°). This greater range of 40° is due to the cooling effects of the altitude of the high slopes and plateaus of Northern India. By including the product of Mexico and the Central American states, though small, the North American range may also be greatly extended. Thus from Nicaragua to the Mackenzie river wheat reaches across 50° of latitude.

Wheat is so important that every effort will be made to widen its areal and its latitude range. This will be accomplished in part by irrigation. In the last census year, 1899, 99 per cent. of Arizona wheat was irrigated. This territory is a small producer, but Colorado and Utah, much larger growers, watered 84 and 57·4 per cent. respectively of wheat lands. The three states of the Pacific coast, which are larger producers, irrigate but a small part of their wheat. In the year named, all the Cordilleran states, with Nebraska added, irrigated 14·1 per cent. of their wheatfields, and raised on this area 17·7 per cent. of their crop. This shows that the yield can be enlarged where wheat is already grown by dry farming, as well as by bringing new lands under the ditch. The cost of irrigation works, however, may make extensive wheat-growing impracticable, because other crops permit more intensive farming and offer larger returns. Our conclusions must be that only a moderate expansion of American wheat will be due to irrigation.

Agricultural exploration and the importation of varieties may be expected to show, and indeed are now showing, much greater results. Some time ago the Department of Agriculture brought from the Crimea and naturalized in Kansas a red winter wheat, which is described as high in hardness, yield, milling value, and in its resistance to disease. Various other Russian sorts have served to push the wheat areas westward into the vast semi-arid regions where water is too limited for extensive irrigation, and which, therefore, must be given over to pasturage unless the crops can be adjusted to small rainfall. These varieties belong to the durum, or so-called macaroni wheats, and are commonly raised not only in Russia, but in Turkestan, Algeria, and other parts of the world where the climate is dry and hot.

A climatic comparison of the Great Plains, which cannot grow the usual varieties beyond the one-hundredth meridian, shows that the American semi arid belt has 3 inches more rainfall than the great home of macaroni wheat on the plains of the Volga.* The author here referred to, also characterizes the soils of the plains as a counterpart of the "black earth" of Russia. The first introduction of Russian durum was made in the United States in 1864, and experimental proof of its value has become conclusive and final. The area suited to its growth extends in a wide north-and-south belt through the Dakotas, Kansas, Colorado, Oklahoma, and Texas. In 1906 the production of durum wheat in the United States had risen to 50,000,000 bushels, with a growing export demand in southern Europe as its qualities are known, and a larger domestic use accompanying development in milling methods and the enlarging of the macaroni industry.

Both yield and areal expansion have been assiduously promoted in North America by skilful selection and cross-breeding. Prof. W. M. Hayes estimates that farmers have increased the yield of maize 20 per cent. by selecting the best ears and they have also pushed the corn belt northwards.† According to the same writer, the past century saw the sugar content of the sugar beet doubled through selection by European seed-growers. Other important results from plant breeding and selection are familiar, and it has been shown by ample experience that no vegetable product

* 'Macaroni Wheats.' M. A. Charleton. Bull. No. 3, Bureau of Plant Industry, U.S. Dept. of Agriculture.

† Yearbook, U.S. Dept. of Agriculture, 1901. 218.

is more plastic than wheat. Different conditions in the United States have modified wheats in colour, hardness, moisture, gluten, and albumenoids, and have changed winter to spring, and spring to winter wheats. According to Hayes, a single variety known as Minnesota No. 169, bred at the experiment station, has raised the yield in that state no less than 5–10 per cent.

Among the most persistent and successful efforts in breeding new varieties are those carried out under the direction of Dr. William Saunders at the Central Experimental Farm, Ottawa, and at the other experiment stations of the Dominion of Canada. This work has peculiar interest, because one of the chief aims is to breed wheat suited to northern conditions. Where vast areas are suited to wheat in surface, soil, and potential transportation, it is of the utmost importance to secure early ripening and conformity to the shortness of the summer season. At the same time high quality must be preserved, since the chief present value of the crop is for the purposes of export.

The most important of these new varieties are the Preston, Stanley, Huron, and Percy.* Preston is named by Dr. Saunders as the best known of the early wheats, and the four named were all originated at Ottawa in 1888, by crossing Red or White Fife with Ladoga.† As compared with the old and standard Red Fife, these varieties all ripen four to twelve days earlier. Their yield, colour of flour, baking strength, and market value are all high, and the early ripening therefore extends the wheat belt northward to a significant degree. The parent Fife hold its place where early frosts are not feared, but the new breeds are invaluable in latitudes where a single early frost puts in jeopardy the labours of an entire year. We need not suppose that the process of adjustment to northern conditions has yet reached its limit.

The limits of this paper allow little more than mere mention of the profound effects on American wheat culture, of conditions of production, manufacture, and transportation. The vast interior plain of North America, ranging from warm to cold temperate as one passes from the lower Mississippi to the upper Mackenzie, has provided not only an unlimited expanse of soil, but offers a surface on which the modern machinery of production and transportation can operate. The plains of Russia and Argentina fall into natural comparison, but here the inventive genius and enterprise of the North American step in and give present supremacy, and, so far as we can see, this advantage will project itself over many years of the future.

We may indeed consider transportation as important as production, for otherwise wheat has little value to grower or consumer. Genesee wheat was little more than the bread of a few pioneers before the digging of the Erie canal. To send a barrel of flour from western New York to Philadelphia cost $1.25.‡ Grain and flour in general could not bear the cost of transportation for more than 150 miles. In 1825, 50 cents per bushel was considered a large price on the Ohio river, and indeed, after a haul of several days to the river, the farmer commonly got 25 to 30 cents, and that in trade.§ In that year wheat brought 25 cents in Illinois, 80 cents in Petersburg, Virginia, and flour $6 per barrel in Charleston, South Carolina. Similar differences prevailed in France, for in 1847 the average difference of the price per hectolitre in different parts of that country was 26 francs. Since 1870, the

* 'Preston and Other Early-ripening Wheats.' C. E. Saunders, Cerealist. Bull. of Central Experimental Farm, March, 1908.

† Two hundred new varieties are said to be now in the process of testing at the Canadian experiment stations.

‡ McMaster, 'History of the United States,' vol. 3, p. 463.

§ F. J. Turner in 'American Nation,' vol. 14, pp. 105–106.

difference has averaged 3.55 francs.* Similarly, prices have become equalized among nations as well as sections, and there is now a world market for wheat, which, according to the experts in economics, cannot be widely or for long disturbed by speculation. The world's crop is becoming available for the world's hunger, and in this transformation the trans-Atlantic highway and the American railway and waterway have borne the largest part. The same author says, "In respect to no other one article has change in the conditions of production and distribution been productive of such momentous consequences as in the case of wheat."

It was the building of railroads and the development of lake navigation that enabled the states of the old North-West to replace the Atlantic states as the grain centre, and which in turn gave the new North-West its present supremacy. And now history repeats itself in the Canadian North-West, in the multiplication of trunk lines and spurs, in the extension of through lines of transportation from Europe to the St. Lawrence, from the St. Lawrence to the Pacific, and from Vancouver and Prince Rupert to the Orient. The grain elevator also has extended its useful sway from Buffalo, Chicago, Minneapolis, and Duluth, to Winnipeg, Prince Albert, and Edmonton. The development of Pacific steamship lines, the opening of the Mississippi, a canal from Lake Huron to tide-water, and the possible utilization of the Hudson bay route, are all further steps in making North America the central bread-grower of the world.

The future of the United States in the universal wheat market is of peculiar interest both to her own citizens and to those of Canada. This depends on two factors: possible production and the possible population. As to both of these factors and the resulting future in export trade, opinions differ greatly. So acute an observer of our affairs as M. Leroy Beaulieu,† referring to the fact that for some years increase in wheat exports has not been more rapid than growth of population, believes this will continue to hold true. He grants that export wheat is likely to remain at its present high level for some time to come, but little increase is probable, the predominance of agricultural exports will pass, and manufactured products will take their place.

Mr. James J. Hill is yet more emphatic,‡ holding that "We are approaching the point where our wheat product will be needed for our own uses, and we shall cease to be an exporter of grain. There is still some room in Canada, but it will soon be filled." That there is some inconsistency in Mr. Hill's utterance appears in the view expressed in the preceding paragraph of his address, that only one-half of our farm areas is improved, that this half might be made, by ordinary care and intelligence, to double its production.

Similar views are set forth by Mr. J. C. Williams,§ who, referring to a falling off in production and the increase of home use, thinks it "quite possible" that the United States will become a permanent importer of wheat under normal conditions. To these opinions may be added that of Dondlinger:‖ "With the increase of population and local consumption, the internal and export movement of wheat will greatly decrease, and American wheat will be a factor of declining importance in the international grain trade." By American, this author no doubt means the product of the United States. He holds that diversification and rise of land values will decrease wheat acreage in the west, though this loss may be in a measure offset by the adoption of new areas in east and south.

In addition to these recent views, it is not out of place to observe that other

* 'Rand's Economic History since 1763,' p. 315.

† 'The United States in the Twentieth Century.'

‡ Conference of Governors, 1908, *Proceedings*, p. 72.

§ *Science*, N.S., vol. 21 (1905), p. 458.

‖ 'Book of Wheat,' p. 305.

and earlier prophecies now read curiously in the light of history. Edgar * quotes the conviction of John H. Klippart, writing in Ohio in 1859, that the limits of the wheat area in the United States had been reached, and that, without increase of yield, the surplus would "by the next census be measured by the algebraic quantity of minus." So late as 1884 a high foreign authority expressed the opinion that the wheat trade in America had reached its limit, because of the exhaustion of the soil and the prohibitive cost of freight from remote districts. These forecasts may well have less real basis than those of recent years, but they at least hint at the pitfalls of prophecy, and admonish us that human wisdom rarely covers all the unknown factors of a hard problem.

It will be prudent, therefore, to discuss the first of the two great factors in a wholly general manner. Can the United States largely increase its crop of wheat? Another wheat expert, Mr. E. C. Parker, writing in the *Century Magazine* in September, 1908, less than one year ago, thinks the home demand will soon stop exporting in any quantity. At the same time, he exhibits a strong array of means for strengthening the industry, and considers it "hard to imagine a wheat famine in the immediate future." Indeed, to fear for the wheat-supply of many generations to come is pessimistic. According to Mr. Parker, we shall have bread enough, but not to spare.

Some means of increasing the product have been considered. It may be admitted that increase by irrigation for export uses is more than doubtful, but it may also be claimed that watered lands will largely care for the bread of the increasing Cordilleran population. If agricultural exploration has given us a crop of 50 million bushels of durum wheats, the extent of available semi-arid lands suggests the probability of a large increase on demand. The production of early wheats will increase the Canadian crop more than that of its neighbour, but may aid in naturalizing the grain at higher altitudes in the West. There is an unknown amount of land east of the Mississippi to be rendered fit for cereals by drainage, for, as compared with Europe, we of North America know nothing about utilizing waste lands.

It is wise, therefore, to accept the dictum of a recent writer,† that "the future growth of cereal production will depend more upon improved methods of agriculture than upon the addition of new lands." Any one with confidence in the new American agriculture must, it seems to the writer, have large faith here. A table of comparative yields per acre is not a pleasant sight to a citizen of the United States. The record of a few leading countries is appended. It gives the average 1899 to 1904.

United Kingdom	32·4
Germany	28·1
France	20·8
Hungary	17·6
United States	13·7
European Russia	9·7

The yield for Canada in 1904 was 16·8 bushels. In 1908 Canada's yield of spring wheat (the bulk of her crop) was 16·03 bushels, and of winter wheat 24·40 bushels. It should be added that in the United States the yield for 1904 was 14·5 bushels. For 1908 the yield was slightly under 14 bushels. Reasonable confidence in the soil and future tillage south of the 49th parallel offers hope of large increase in the coming generation. Sixty years ago France was producing

* 'The Story of a Grain of Wheat,' p. 87.

† E. L. Bogart, 'Economic History of the United States,' p. 295.

less than 15 bushels per acre. A duty on imports practically prohibitive has forced the adoption of thorough tillage, and made it necessary for the French farmer to fertilize and use every other expedient for winning the largest result from his small fields. It may be said that labour conditions are very different, but the fact remains that these anciently tilled fields have been made to grow a vastly larger crop than they raised seventy-five years ago. It is significant that the farms of the United States average 150 acres, while the French farms average 20 acres. Leroy-Beaulieu refers to our small outlay for labour as evidence that we have little intensive cultivation. The writer of this paper has elsewhere shown * that east of the arid region we had, at the last census, but one agricultural worker for each 91·4 acres. Such facts are eloquent of our future possibilities, not only in wheat but in every product of the soil. What is true of the United States is more true of Canada with its ample soils and sparse population.

A South Carolina writer † asserts that tillage has, in some cases, made an increase per acre of more than eight bushels. Prof. Harry Snyder of the University of Minnesota asserts that the "yield per acre of wheat in the United States is much less than the soils are capable of producing." ‡

Mr. W. C. Ford, referring to the increased yields of France,§ utters a general principle which should be the inspiration of every North American farmer and the basis of reasonable optimism for every loyal citizen of the New World, "To this march of scientific agriculture there is no end." California is said to have used six times as much artificial fertilizer in 1900 as in 1890, and one of the latest bulletins of the Minnesota Agricultural Experiment Station, of date June, 1908, deals with the rotation of crops. Fertilizers even in the Red river valley are said to have increased the yield in some cases from fifteen to twenty-six bushels. Minnesota is not an old state, but is taking up the problems of the present and the future, and is quoted here, not as an exception, but as a sample of general practice throughout the United States.

The other great factor in the wheat problem is the increase of population. Space forbids more than a word. The writer has given his views on this somewhat difficult subject in another place.‖ In his belief, the ordinary prophecies of increase in the coming generation are exaggerations. Mr. James J. Hill, for example, thinks we shall have 200 million people in the United States by 1950. Let the reader observe the following rates of increase:—

Decade before	1880	...	...	30·2	per cent.	increase
" "	1800	...	...	25·5	"	"
" "	1900	...	...	20·7	"	"

Here is a drop of nearly 5 per cent. in each decade. The population of 1899 (census of 1900) was 76,085,794. The population for the Thirteenth Census, now about to be taken, may be estimated at 88 millions. This gives an increase of 15·6 per cent. in the last decade, and maintains the descending rate of previous periods. If we allow a drop of only 1 per cent. for coming decades, there would be in 1949, the year of the Seventeenth Census, a population in round numbers of 144 millions. This is a sufficient comment on the prevailing extravagances in estimating our future numbers in the United States. It is, perhaps, more possible that 1950 will not see a population of more than 130 millions. But let us grant

* "Distribution of Population in the United States," *Geogr. Journ.*, October, 1908, p. 383.

† *S.C. Bull.*, vol. **56**, p. 12.

‡ Art. "Wheat," *Encyc. Americana.*

§ *Pop. Sci. Monthly*, vol. **53** (1908), p. 8.

‖ *Ibid.*, September, 1909, "Capacity of the United States for Population."

150 millions in no very distant future. At six bushels per capita, 900 million would be needed at home. More than 700 million bushels have already been raised in one year. An increase of four bushels per acre on present wheat lands would about fill the gap. An increase of 10 to 12 million acres under good tillage would still provide for the present scale of export. It is safe to expect that this cereal, as an essential food, will press for its place, and all reclamation and adaptation of lands now idle, to other crops, will tend to release land for wheat.

Regarding it as fairly probable that the United States will not materially increase its exports of wheat, the Canadian product assumes new interest, not only for the farmer and economist of the Dominion, but for every student of the subject. It would be needless, and indeed presuming, to bring to this place from across the border detailed statements as to the history, or confident predictions as to the future, of Canadian wheat.

In comparison with some of its competitors, Canada is old in the industry, having raised over 20 million bushels in 1827, while Argentina began to raise wheat in 1882. Recent developments in the North-West belong to the experience of many who are still foremost in the field. Fort Garry has been Winnipeg but for a single generation, and the Canadian-Pacific railway entered the city so late as 1881. It has already been observed that the Canadian yield is high, owing to the native fertility of its prairies, and the greatest crop ever raised from unfertilized land is credited to Western Canada in 1901, when 63,425,000 bushels were raised on something more than 2,500,000 acres, an average yield of more than twenty-five bushels.

The following tables show the progress of wheat in Manitoba, Saskatchewan, and Alberta from 1900 to 1908. The figures are kindly furnished the writer by Mr. A. Blue, chief officer, Census and Statistics Office.* The product for 1908 is taken from the *Census and Statistics Monthly*, Ottawa, December, 1908.

Manitoba.

	Bushels.		Bushels.
1900	18,352,929	1905	47,626,586
1901	50,502,035	1906	54,472,198
1902	53,077,267	1907	39,688,266
1903	40,116,878	1908	50,269,000
1904	39,162,458		

Saskatchewan.

1900	4,306,091	1905	31,799,198
1901	11,956,069	1906	50,182,359
1902	13,110,330	1907	27,691,601
1903	15,121,015	1908	34,742,000
1904	15,944,730		

Alberta.

1900	797,839	1905	3,035,843
1901	857,714	1906	5,932,267
1902	850,122	1907	4,194,435
1903	1,200,598	1908	6,842,000
1904	938,200		

The exports of Canadian wheat ranged from 16 and 9 millions respectively in the years 1900 and 1901, to a maximum of 43,654,668 bushels in 1908. The Ontario crop is usually over 20 million bushels, but it is from the north-western

* Letters of March 19 and 24, 1909.

provinces that future growth is chiefly expected. Dr. William Saunders* states that during 1908 experiments have been carried on in the Peace river district, at Fort Vermilion, 350 miles north of Edmonton, where the crop amounted to 35,000 bushels. He adds the important statement that "there seem to be no climatic differences there which are more difficult to overcome, than in the immediate vicinity of Edmonton."

If there be prophecy as to Canada's future product, her own experts must play the part of seer. We have not seen that Dr. Saunders retracts or in any way modifies his "reasonable prophecy" of 1904—that wheat, grown on one-fourth of the land suited to it in the Canadian North-West, with the yield of Manitoba for the previous decade, would bring a crop of more than 800 million bushels, which, as he shows, would feed 30,000,000 of people in Canada and three times supply the import need of Great Britain. If there be such a surplus of good soil as three-fourths, this would leave ample room for diversified crops, and for such rotations and fallowing as might be needful in future years to meet the declining production of the prairie soils.

Sir William Crookes, in 1898, allowed from credible estimates six million acres of wheat land for Canada in the following twelve years. The acreage of 1908, after ten years, but slightly exceeded his figure. His fears, however, as to inadequate population to work the wheat lands are not likely to be realized. When he read his address at Bristol he could not have foreseen that spectacular migration across the border from the south, which now plays so large a *rôle* in the North-West. In the year 1898 this immigration brought 9119 settlers into Canada. In the fiscal year of 1908–1909 the number had risen to 59,832, and had become a theme of interest to both countries. Sixty thousand settlers, mainly going to wheat farms and bringing in capital and experience, means immediate and large expansion of Canadian wheat, and an annual product per capita far exceeding anything that any wheat-raising country has known.

The population of Canada has always increased slowly, beginning with 240,000 in 1801 and rising in 1901 to 5,371,315. But it is precisely in the wheat provinces that recent percentages of increase have been enormous, so that Canada promises to give itself to a great agricultural specialty, and remotely, if ever, will come the time when her population will press hard upon her productive capacity. Unlike the United States, she must confine herself to products of temperate climates, and her greatest reliance for exchange must, it would seem, be breadstuffs. Immigration into Canada since 1901 has brought more than one million people, and if the population in 1908 were seven millions there was a per capita production of wheat of 16 bushels. This ratio will, no doubt, be much higher in the near future.

It is easy to refute prophecies which the event has already nullified, but it is, nevertheless, sometimes useful to recall them. In his famous address of 1898 Sir William Crookes concedes his statements to be alarming, but asserts they are based on stubborn facts, and that "England and all civilized nations are in deadly peril of not having enough to eat . . .; as mouths multiply food resources dwindle . . .; our wheat-producing soil is totally unequal to the strain put upon it." Great Britain then needed 240,000,000 bushels of wheat, of which she raised one-fourth and imported the rest. Sir William regards as a burning question what to do to avert starvation if crops should fail or nations combine in hostility, especially in view of the world's increase of bread-eaters. The wheat-growing area was strictly limited; there was no land left in the United States without cutting into maize, hay, and other crops, and the export of 145,000,000 bushels would soon be required

* Letter to the writer of date March 15, 1909.

at home. In the world's crop for 1897–1898 he gives the United States 510,000,000 bushels. As it turned out, there were in the process of harvest, when Sir William was reading, 675,000,000. The average crop for eleven years, 1898–1908, has been 643,668,762 bushels, giving an average increase beyond his figure of 133,668,000 bushels, almost enough to cover the export amount then stated. The world's crop for 1897–1898 was said to be 1,921,000,000 bushels, leaving a deficit, but for supplies carried over, of 400,000,000. He thought the wheat lands of all nations, brought to their utmost capacity, might raise the total to 3,340,000,000, or within 17,000,000 bushels of what the eaters of wheat bread would require in 1931. We now know that the world's crop eight years later, or in 1906, was 3,423,134,000 bushels, and the limit is nowhere in sight, and cannot be conjectured within a billion bushels by the keenest student of the wheat problem. Sir William felt that performance had lagged behind promise in Canada, and he observed the modest export of less than 9,000,000 bushels, which has now been raised nearly fivefold.

It is hazardous to set limits to wheat in view of possible unknown factors of production, and discussions have not taken sufficient account of the limitation of population which exhibits itself among the nations of higher standards, which are precisely the bread-eating peoples. Without regard to wheat this limitation would be operative, but any pressure on the wheat-supply would foreshadow itself before the pinch came, and would tend still further to restrictions of population. We may therefore comfortably come back to an earlier conclusion of an American economist,* "In short, it would seem as if the world in general, for the first time in its history, has now good and sufficient reasons for feeling free from all apprehension of a scarcity or dearness of bread."

Looking, in conclusion, at the world field, the only great importing countries are in Western Europe, or more truly North-Western Europe. An increased demand in that region should readily be met by development in Canada, Russia, Argentina, Egypt, India, South Africa, and Australia. We may thus even leave out the United States, and we might omit India, should ampler distribution of her wheat at home be made to avert her too frequent periods of famine. Of the greater producers, Argentina is far from her market, is undeveloped and in some degree uncertain. Russia is backward, and will not for more than a generation bring her vast resources to full effect in the world's market. It is North America which has the land, the progressive appliances, the skilled energy of production, and the facilities of transportation to supply the bread market of coming decades. No citizen of the great Republic need harbour a jealous thought if in that market the major place should come to his northern neighbour.

FLOODS IN THE GREAT INTERIOR VALLEY OF NORTH AMERICA.†

By LUELLA AGNES OWEN.

THE conditions producing these floods, the diversified character of their consequences, and the possibility of advantageous future control of the devastating surplus, are questions of vital interest to the American nation, on account of their ever-increasing importance to a group of the most richly productive states and to the traffic of the entire country.

* Mr. D. A. Wells in 'Recent Economic Changes,' p. 177 (1889).

† Read at Section E, British Association, Winnipeg, August, 1909.

Although the obvious causes are excessive local rainfall with run-off from the melting of heavy snows in the mountains, it is possible that both may occur without serious results if weather conditions shall favour an early and slow-melting season, beginning with open rivers to carry out the flow; and if the excess of rainfall shall either follow a season of comparative drought in the valley or fall so gently that nearly all sinks into the natural storage reservoirs of the subsoil. The violent downpour, on the contrary, is mainly lost in run-off which goes to swell the flood conditions, carrying with it in solution a considerable quantity of surface soil usually designated "wash." This ancient process of denudation has recently become the subject of vigorous protest as "the incalculable, irreparable loss of fertile soil from our mountains, grazing lands, and fields," the loss for the whole country being estimated approximately at one billion tons per annum. Extensive forest planting is urged as the method of reducing this loss to less distressing figures; but all cultivated lands must still remain subject to the levy of Nature's tax, and mountain peaks also must continue to be denuded of the products of their slow disintegration to contribute fresh elements to exhausted soils.

Interest in the great floods increases with study of their various developments under the influence of local conditions, the present year affording opportunities especially favourable to purposes of such investigation. Exceptionally heavy snowfall in the Rocky mountains gave an early forecast of the volume of run-off to be anticipated after thawing should commence, which might have been as early as March or April, but the severe winter dragged its length over all the spring months, and heavy snowfall continued into June, when the "June rise" might reasonably have been expected in the lower valley. This rise, however, was delayed beyond every precedent, and recorded its highest mark at St. Joseph on July 9, at Kansas City on the 13th, and at St. Louis on the 16th, making it the latest of all floods of record in sixty-five years with the single exception of that of September, 1905, due wholly to local rains. Great as was the volume of run-off forced rapidly down into the valley by the sudden warmth of midsummer eating into vast snowfields, it might possibly have passed through the channel of the Missouri and reached the Gulf with very little overflow if it had not been met everywhere below the Dakotas by streams at high flood from excessive local rainfall repeated at frequent intervals. Any fairly intelligent farmer or other weather-observing resident has sufficient knowledge of valley meteorology to forecast such rains to meet the high stage of mountain overflow, even though innocent as their flocks and herds of thoughts pertaining to cause and effect of air currents.

During the early stages of high water the contributions from swollen local streams greatly increase the volume and add violent speed to the already swift current of the Missouri and lower Mississippi rivers. After the higher stages are reached, these strong and swift currents act as effective dams thrown across the outlets of smaller streams, and, by checking their discharge, force a deluge of backwater over the valley of each. This peculiarity was a predominating feature of the high water in Missouri, Iowa, and Kansas in the present year, as shown by the Hannibal and St. Joseph railroad being wholly impassable for several days for the first time in its just completed fifty years of service, and by the serious overflow over the full length of Des Moines river. The conditions have been so many times repeated at Topeka and other points in Kansas by the closing of the Kaw at Kansas City that the familiar picture requires neither description nor comment.

Since local circumstances so largely affect the volume carried by the main stream and are known to vary with different seasons, it becomes evident why the

geographical point of greatest flood importance is also variable. Thus the highest stage ever reached at St. Louis by any flood of history or tradition was that always known as "the Great Flood of '44"; at Kansas City the flood of 1903 reached a stage 1 foot higher than the record of 1844, while the highest at St. Joseph, Omaha, Sioux City, and Yankton was in 1881. These three are the most notable of fourteen great floods that have made records in the valley within the past sixty-five years, the record of each being in some particular peculiar to itself. In the memorable year of 1903 an exceedingly high stage of water was general throughout the entire valley between the mountain ranges of the east and west, and resulted in the first public approval of the proposed system of vast storage reservoirs on headwaters for the supposed future control of such devastating surplus. Few of the river cities of the interior are situated like St. Joseph on the bank of a turbulent river, and yet at a safe elevation above the flood-plain, so the losses of that year were widespread and financially enormous, being estimated for the vicinity of St. Louis alone at more than the price paid to France for the territory of Louisiana. An involuntary sojourn in Kansas City during the appalling period of the cresting of this flood and the beginnings of its subsidence, afforded a most valuable opportunity for observations. On May 30 the waters spread over the southern entrance to the city and closed the last approach, shutting off all communication with the outer world even by wire or boat—landing-places being lost beneath the waves of a rushing torrent carrying a burden of promiscuous wreckage, including trees and houses. The valley was filled from bluff to bluff with the turbulent, muddy waters which on June 2 completely submerged the entrances to the main waiting-room of the Union station, only the transom-glass remaining visible. This high stage continued stationary for two days, and then began to very slowly subside, proving the existence of a drainage basin with its only outlet towards the east. Further observations revealed that within a distance of 60 miles the surrounding watershed attains altitudes of 1000 to 1100 feet above sea-level, forming a barrier capable of having retained glacial floods of sufficient depth to have deposited the loess bluffs with more than their present height. Prof. Geo. Frederick Wright, a few weeks later, traced this barrier across the state, and found proof of its importance in relation to aqueous deposition of loess in the presence of northern boulders on the summit of the bluff near Tuscumbia, a point previously supposed to have been well beyond the drift limit.

The flood of 1881 was peculiar in that it occurred in March and the first half of April. Unprecedented early melting in the mountains sent out summer torrents before the upper Missouri was clear of its winter ice, which caused the formation of a vast ice-jam near Yankton. This threw a great body of water over the surrounding country, where it accumulated to such depth that a river steamboat was carried more than 6 miles inland by the current and left to its fate. When the jam finally yielded to explosives, the water rushed down the Missouri in a flood whose front presented the peculiar appearance of a series of perpendicular walls from 2 to 4 feet in height. Augmented in its course by the inevitable rains, it spread from bluff to bluff throughout the entire length of the valley.

The flood of 1908 was due to excess of rain at the time of the "June rise," but its unusual phase was copious rains in even the arid portions of Montana and Wyoming, whose flooded streams swept over valleys usually exempt.

The great flood of 1844, on the contrary, affected no portion of the upper river. An old account states that, as usual, it was caused by heavy rainfall with the June rise. "The downpour had been excessive for weeks, and about the middle of June all the lowlands along the river, from the mouth of the Kaw to the Gulf of Mexico, were submerged, the waters extending over the entire valley between bluffs across

the state of Missouri, and of such depth that steamboats disregarded the channel to make short cuts across fields. A marked peculiarity was the fact that the flood was confined entirely to the lower river. It did not extend above Kansas City, and the river above that point during the entire season was unusually low."

The flood of September, 1905, was exceptionally notable for two reasons. It was due entirely to rainfall; and occurred at a season which is generally the dryest portion of the year, and the outflow from the mountains is also at its lowest stage.

The consequences of these high waters are necessarily varied in character, but are by no means essentially destructive, since Nature's law of compensation has never been repealed, the losses of one section becoming accessions to another. In present geographical development the results of geological progress are written. Study of this historical record revealed the origin of the great valley to have been in the upheaval of two mountain ranges, whose drainage gathered in lines of depression in order to gain the level of a receding ocean; and through all the changes of successive periods, including glacial and inter-glacial epochs, solid matter varying in quantities as well as in chemical richness was carried in suspension by strong currents to add depth to the valley and extend it for hundreds of miles southward by forcing back the sea to the present limit of the Gulf of Mexico. But man, having taken possession of the unfinished country for the richness of its products, protests against the continuance of the vast scheme of removal and rebuilding as entailing loss of his possessions in one region to overwhelm and destroy his unguarded works in another.

Since it is known that floods are not of annual occurrence, that they are confined almost exclusively to the lower and middle portions of the valley, and their chief cause is excess of local rainfall, it can be readily observed that storage reservoirs on the headwaters of the Missouri could by no possibility affect any perceptible degree of relief. Some apprehension might, however, be justly entertained that in diverting the headwaters from the main stream its already well-populated valley would be wholly deprived of the present pure and wholesome supply of mountain water, of many miles of commercially navigable stream, and the purifying element of a magnificent drainage system. Means of safe-guarding against flood disasters would, therefore, appear to offer more reliable promise of effectiveness if closer connection should be established between the principal cause of trouble and the location of projects designed for actual and ready relief. When such measures shall be adopted they will doubtless include a substantial levee wherever experience has shown its necessity to be imperative, and a system of emergency canals. If the latter should be so constructed as to be serviceable as public highways at all times when not temporarily closed for emergency service, they would meet with general favour rather than the opposition of property-owners relinquishing rights.

THE VOLCANIC ERUPTION IN TENERIFFE.

AFTER a period of quiescence lasting for a hundred and eleven years, the volcano of the Peak of Teneriffe has again burst into activity, and considerable streams of lava have flowed down its north-western quadrant, threatening the safety of some of the little villages which are planted on its slopes. Another has been added to the list of important eruptions of the twentieth century, a list which already includes the West Indian eruptions of 1902–1904, the great outbreak of Vesuvius in 1906, the important eruptions of Savaii in Samoa during the last two years, and the minor eruption of Etna in 1908.

The whole of the Canary islands, with Madeira and the Azores, consist of recent and Tertiary volcanic rocks, and the Peak of Teneriffe, which rises to a height of 12,192 feet, is one of the greatest volcanoes of the world. The Peak is a steep-sided cone which stands within a great circular crater or "caldera"; the floor of this, known as the "Cañadas," has an elevation of 7000 to 7500 feet, and is covered with pumice and volcanic sand. This caldera is the remains of the first period of activity, and bears somewhat the same relation to the Peak as Somma and the Atrio have to Vesuvius. Pumice and black rugged flows of obsidian cover the sides of the Peak, and many parasitic craters of all sizes stud its surface. On the west of the main summit, a large crater, known as the Chahorra (10,500 feet), is a conspicuous feature; it is separated from the Peak itself by a saddle-shaped depression occupied by very rugged flows of obsidian. At the top of the Peak there is a small crater, but for centuries this has been in a state of repose, or, more correctly, in a solfataric condition, and the rocks around it are soft, earthy, and impregnated with sulphur. From Chahorra, on the other hand, great lavas were emitted in 1798, and this seems to be the active centre which has superseded the summit crater. The lava of that eruption broke out along an east-and-west line of fissure situated near the base of this cone, and on the fissure several parasitic cones were formed. After overflowing the level surface of the Cañadas below, it spread out in the direction of Guia, a hamlet to the west of the Peak, but was hemmed in by the cliffs which face the Cañadas on that side, and came to rest before much damage was done.

Nearly a century earlier (in 1706), a great lava-flow destroyed Garachico, which stands on the coast about 7 miles north-west of Chahorra. This lava is still in a remarkably fresh condition. It arose probably from fissures and small cones in the north-west corner of the old Caldera, and found an easy outlet down the valley which breaches the old cone on that side, and leads down to Garachico. The only other eruption which has taken place since the occupation of the islands by the Spanish was in 1704, when a crater was formed on the south-east side of the volcano, near Guimar, and emitted a large stream of lava which threatened that town. It destroyed the church, but stopped before reaching the other houses, and the volcanic activity lasted for a year.

In Teneriffe small earthquake shocks generally precede the eruptions, but these have never proved of great intensity. Apprehension, however, had been awakened among the inhabitants for some months past owing to their unusual frequency, and it is said that on some days the earth-tremors had been continuous for hours. They were felt most about Icod, on the north side of the island, but attracted attention also in Orotava. On Thursday, November 18, in the afternoon, detonations were heard by the residents in Orotava, like the discharge of heavy cannon at intervals of a minute or less. Shortly afterwards word was received that an eruption had taken place near Garachico, and over the intervening hills smoke could be seen ascending in the air. The noises continued all night, and when darkness fell the glow of the red-hot lava was visibly reflected from the clouds. Many of the inhabitants hastened to leave the villages on the north side of the mountain and take refuge in Orotava.

Next day it became clear that the eruption was really in the vicinity of Santiago, which stands 6 miles west-north-west of the peak. A stream of lava about half a mile wide and 8 feet deep was slowly travelling down the valley towards the village. Thereafter reports arrived that another lava-flow was proceeding in a northerly direction towards El Tanque, which lies about 2 miles from Garachico. The rate of advance is variably stated, but it must have depended largely on the slope and configuration of the ground. Some of the telegrams

published in the newspapers give the length of the lava-stream as 3¾ miles, and say that it advanced half a mile in twenty-four hours. The fact that it was near Santiago on the 19th shows that it must have flowed rapidly at first, but its progress was arrested or greatly reduced in two or three days, as it is certain that Santiago has not been invaded, and the stream descending towards El Tanque has also come to rest.

The latest reports state that the eruption took place on level ground to the south-east of Mount Bilma, and not far from Chahorra. The craters are situated on a fissure which runs west 15° N. at an elevation of 1525 metres. While the fissure at present active is probably not the same as that from which the lava of 1798 proceeded, it is sufficiently close to it to confirm the opinion expressed by Leopold von Buch in 1829, that this is the principal orifice of the Peak under present conditions. Many parties have visited the scene of the eruption from Orotava and other places, and have found it easy to get within 400 yards of the craters. The wind during the early part of the outburst was persistently from the south, and a cone of ashes, stated to be 400 to 500 feet high, has been built up on the north side of the orifice. Clouds of steam and showers of stones were being projected at intervals from the central crater and from two apertures on the sides of the cone, but the flow of lava seems to have lasted for only a few days, and had nearly ceased on November 26. The distance from Santiago is 3 or 4 miles.

While it is too early to conclude that the eruptions are at an end, there are certain inferences from the facts of which we are in possession that may be safely drawn. As on two previous occasions (1706 and 1798), the north-west quadrant of the volcano has been the seat of activity. Near the base of Chahorra, or to the north-west of it, a fissure has opened and a large amount of lava has been emitted, which has taken its natural course down the valleys towards the sea. The great ring-shaped crater-wall which girdles the base of the Peak is a sufficient protection to the other parts of the island. Probably the lava will continue to creep forward slowly for some time, but the district is not thickly inhabited, and there has been no loss of life. It is interesting to note that the history of the Peak indicates that eruptions tend to recur at intervals of about a century.

JOHN S. FLETT.

CENTRAL ASIAN ARCHÆOLOGY.*

THESE two quarto volumes present us with records of considerable value, dealing with the archæological, zoological, and anthropological aspects of a site at Anau, near Ashkabad, in Turkestan. Russian work in this region has been concerned mainly with geology, and even so is inaccessible to the average Englishman; so that we have here a revelation of prehistoric culture which fills up one of the great gaps in our knowledge of the Orient. The editor is to be complimented on his presentation of the results, which are fully detailed, excellently illustrated, and altogether adequate.

Those who perused the record of the preliminary expedition of 1903 will remember that it was a reconnaissance. Prof. W. Davis, of Harvard, and Mr. Ellsworth Huntington made a rapid survey of the Western Tian Shan mountains, in order to get "a broad view of the region and its development," while Prof.

* Explorations in Turkestan. Expedition of 1904. Prehistoric Civilizations of Anau. Origin, Growth, and Influence of Environment. Edited by R. Pumpelly. 2 vols. Carnegie Institute of Washington. Publication No. 73. 1908. 10$.

Pumpelly and his son examined the region from Sir-darya to the Pamirs, mainly for the choice of a suitable site for excavation.

The various members of the expedition "established independently positive proof of at least three distinct glacial and interglacial epochs of the Glacial period, and obtained abundant evidence of the deep-reaching reaction of these upon the topography of the mountains and plain." The relation of these epochs to the glaciation of Europe, particularly of Russia, was brought out. Prof. Pumpelly further tells us emphatically that Richthofen's theory of the wind-borne origin of loess was duly confirmed, and adds that it is the direct product of deflation and disintegration, and arises from alluviation or dry deltas and dry flood plains.

In the report before us, Mr. R. W. Pumpelly determines the changes and history of geological movement from the Pliocene period, the weathering, glaciation, and alluviation of the mountains, deserts, and oases, and presents a study of deltas and oases in connection with their occupation by man. But the interest of these two volumes centres in the archæological work, the excavation of a site chosen in 1903 at Anau, about a quarter of a mile from the Trans-Caspian railway and a few miles beyond Ashkabad.

Prof. Pumpelly deserves congratulation for his great pluck in undertaking, as he tells us, on the verge of threescore years and ten, such an arduous expedition. As far back as 1863, when travelling in China and Mongolia, he had become interested in the phenomenon of the progressive desiccation of the Trans-Caspian region. It was not, however, until forty years later that the opportunity of testing his surmises presented itself, in the form of a grant from the Carnegie Institute. The object of the expedition cannot be better put than in his own words :—

"It had long seemed to me that a study of Central Asian archæology would probably yield important evidence in the genealogy of the great civilizations, and of several at least of the dominant races; and that a parallel study of the traces of physical changes during Quaternary time might show some coincidence between the phases of social evolution and the changes in environment; further, that it might be possible to correlate the physical and human records, and thus furnish a contribution to the time-scale of racial geology."

Everybody will sympathize with this aim. We are sadly lacking in trustworthy chronology earlier than 3000 or 4000 B.C., and what palæontologist, prehistoric archæologist, or anthropologist has not longed to be able to date, with a fair approximation to the truth, the great landmark of the bridging of the prehistoric European-Asiatic "Mediterranean," and the free ebb and flow of animal migration between Asia and Europe?

Before the end of the 1903 expedition, Prof. Pumpelly realized that the problem was not merely geological, but archæological, and fortunately obtained the aid of the experienced archæologist, Dr. Hubert Schmidt, of Berlin. The site chosen consisted of two mounds, 40 and 50 feet high, and the city settlement of Anau. The northern kurgan had already been trenched twenty years before by General Komorof, and pottery lay on the surface and in the different settlement strata of the trench. The mounds represent, not tombs, but the *débris* of adobe dwellings, etc., of successive settlements of peoples, and these extend to a depth below the level of the plain. As the north and south kurgans and the city mound represent a sequence, with some gaps between, we have a very long period of time, represented by the accumulation of *débris* and sand of at least 170 feet. The earliest inhabitants built dwellings of sun-dried bricks; used flint sickles, but no celts; cultivated wheat and barley; spun; painted their pottery with geometric designs; later possessed domesticated sheep; and towards the end of the First Culture (third millennium B.C., according to Dr. Schmidt) began to use copper implements. This

Anau civilization, beginning with the Neolithic, passed through a lengthy Copper Age, but never a Bronze, and by the Fourth Culture period, *i.e.* at the top of the second or south kurgan, appears the Iron Age.

Dr. Schmidt, in seeking external connections for the culture at Anau, says, "The pottery of Anau and its ornamentation show a non-European character." The design of erect-standing triangles, the foundation of the tent ornament, is in direct opposition to the ancient and long-persisting horizontal and vertical ornament of prehistoric Europe. He finds that while the general culture and the early appearance of painted pottery, giving way to an undecorated ware, agrees with that of the old Tell of Susa excavated by De Morgan, the decoration, motives, and styles are quite different. Two objects help to determine the age of the settlements: a three-sided steatite seal of Cretan form, and a copper sickle with bent tang of Ægean shape. These were found in the lower stratum (Third Culture) of the south kurgan, and were assigned by Dr. Schmidt to a period not later than the first half of the second millennium B.C.

Turning to Dr. Duerst's examination of the bones of sub-fossil and later animals, we have a careful and skilled investigation of the remains of horse, ox, sheep, dog, camel, etc. The contributions to our knowledge of the horse are especially valuable, and one of the species appears to approximate closely to Prjevalsky's horse. He claims to have found a domesticated breed of sheep in the First Culture stratum and the shepherd dog in the Second. It seems a daring thing, in our present state of ignorance, to form an absolute chronology on the base of the differentiation of animal forms and their migrations, as deduced from their appearance in different places, but Dr. Duerst, in agreement with Prof. Pumpelly, does not hesitate to tell us that the shepherd dog appeared at Anau c. 5850 B.C., and that the turbary sheep attained its full development 6250 B.C. He adds, "According to Prof. Pumpelly's stratigraphic chronology, which is without doubt the most exact chronological table that we possess, the 20 feet of culture stratum at the base of the north kurgan dates from the latter half of the ninth millennium (8250 B.C.).

Prof. Pumpelly, with youthful confidence, sums up his results as follows: "The evolution of civilization has been traced backward to a time when, before its datings in Babylon and Egypt, man at Anau already lived in cities, cultivated wheat and barley, began the domestication and breeding of the useful animals which are our inheritance, and possessed the fundamental industries and arts, including a certain amount of metallurgical knowledge."

Whence this difference between Prof. Pumpelly's date of the ninth and Dr. Schmidt's of the third millennium B.C. for the beginnings of the civilization at Anau? Prof. Pumpelly says that Dr. Schmidt did not include the zoological testimony of Dr. Duerst, the evidence from the "cyclic" changes, and the accumulation of *débris* on the site. Unfortunately, the cyclic changes recorded by the authors do not help us prior to the beginning of our era. The rates of accumulation of *débris* and sand are such an uncertain factor that no careful scientist would venture to erect a system of chronology upon them. Dr. Duerst appears to owe his dates in the main to Prof. Pumpelly. And the latter, when the expedition became a possibility, suddenly realized, as he admits with praiseworthy candour, that "he had done practically no reading in connection with the subject, and was ignorant of the amount of thought and effort, that during forty years had been devoted to Central Asia." And he allows us to see that he set out to find the "home of the Aryans" and the "cradle of the human race," unaware of the changes that had come over scientists' views in relation to these matters or of the battles that had raged around them. Readers will be disappointed in the failure to correlate physico-geographical changes with phases of social evolution antecedent to

our era. To attempt to establish in one season's work an absolute chronology for a newly discovered civilization when half a century's work in Egypt has still left us in considerable uncertainty as to dates prior to 1580 B.C. seems presumptuous, and the evidence presented tallies as well with the view that Babylonian and Egyptian beginnings antedated Anau as with the reverse.

Although this extravagant chronology vitiates many of the conclusions, it does not detract from the value of the mass of records of all kinds and their excellent presentation in these volumes. C. H. H.

DR. LONGSTAFF'S HIMALAYAN EXPEDITION, 1909.

HAVING at length had an opportunity of testing my instruments and compiling my results at the Survey Office at Debra Dun, I hasten to send my first communication for the *Geographical Journal*.

One of the inducements which decided me to make for the Saltoro pass was the knowledge that the main axis of the Karakoram had never been crossed by any traveller between Younghusband's Muztagh pass and the Karakoram pass itself, a distance of 100 miles in a straight line, and 150 miles as measured along the accepted crest-line. Although the name Saltoro pass has been handed down to us by tradition, there is no record of any one, European or native, having crossed it, and its exact position was uncertain.

When Neve, Slingsby, and I crossed this pass (the Saltoro, 18,200 feet) on June 15 last, we saw before us a huge glacier bounded to the north and east by a lofty range of snow-clad peaks. At first sight we assumed that this glacier flowed northwards as shown on maps; but when, on the following day, we reached the main glacier and were able to examine it, we found that it was flowing to the south. In September, following the independent suggestions both of Colonel Burrard and Sir Francis Younghusband, and with the assistance of Captain D. G. Oliver, British joint commissioner for Ladak, I was able to make my way up the Siachen glacier (Saichar of maps) and establish its identity with the glacier we had visited and surveyed in June. But the Siachen glacier, instead of being some 20 miles in length as has always been supposed, turns out to be more than 44 miles long, and it pierces the range that has hitherto been regarded as the main Karakoram axis.

This discovery has shown that the Siachen is the longest glacier in the Himalayan system, and probably the largest outside the Alaskan and Polar regions, its only competitor being the Inylchek glacier of Merzbacher in the Tian Shan. When we remember that the Siachen glacier drains into the Nubra river, it becomes obvious that the basin of the Indus must extend much farther northwards than has been thought. In short, the Indus-Yarkand water-parting here follows a chain of mountains not shown on any maps, and lying some 20 miles north of the

high range upon which it has been hitherto located. It was extremely interesting to find that the actual facts accorded with the views expressed to me by Sir Francis Younghusband before we started on this journey.

To avoid any possible misunderstanding of my views, I must also add that I consider the description in the survey reports of the mapping of the Saltoro and Siachen regions, viz.: "Mr. Ryall made a rapid sketch of the country, but with sufficient precision to give a good general idea of its physical formation," to be a very modest statement of what was done in 1861 and 1862.

Perhaps our most interesting discovery has been the existence of a group of very lofty peaks, crowning this new chain of the Karakoram, and culminating (about long. 77°, lat. 35° 30′) in Teram Kangri, 27,610 feet in altitude. Thus if my measurements can be accepted, this new peak is only overtopped by Everest, K_2, Kinchinjunga, and Makalu. I feel very considerable hesitation in attaching such an immense height to a peak which has escaped the observation of the Survey of India; but this peak is not a satellite of K_2 or of Gusherbrum. It is the culminating point of a totally distinct *massif*, which so far has not been shown on any map. It should be remembered, also, that Colonel Burrard predicted of this region, that it was the most likely of all unexplored areas of High Asia to contain high undiscovered peaks. In any case, the fear lest I may subsequently be shown to be in error should not, I think, deter me from publishing the results of observations which have so far withstood a fairly severe examination by experienced judges.

If, in view of these new facts, we now reconsider our former ideas of the structure of the eastern Karakoram, we must place the main axis of elevation along a line drawn from K_2 to Teram Kangri, and on to the Karakoram pass. Whether the Karakoram is to be considered as consisting of two more or less parallel ranges, or whether it bifurcates, in the neighbourhood of K_2, we are as yet hardly in a position to state with certainty.

I cannot close this note without acknowledging my indebtedness for the assistance given me by Colonel Burrard, F.R.S., and the other officers of the Trigonometrical Survey, and by Dr. Gilbert Walker, F.R.S., and the Meteorological Department. But it must be distinctly understood that the Survey can accept no responsibility for any statements I have made in this communication. I have also to thank Colonel Longe, the Surveyor-General, for his offer of the services of a surveyor—an offer which I did not feel justified in accepting, as his whole time would have been wasted had we been unable to cross the Saltoro pass.

TOM G. LONGSTAFF.

REVIEWS.

ASIA.

'En Birmanie. Souvenirs de Chasse et de Voyage.' Par le Prince Grégoire Sturdza. (Paris: Plon. 1909. Pp. 236. *Map and Illustrations.*) An unpretending record of shooting experiences in Burma. The book is divided into two parts; the first consisting of extracts from the prince's diary, and the second of general remarks on the geography, the inhabitants, the products, fauna, and flora of the country. A variety of hints and information respecting clothing, equipment, and travelling necessaries are likely to prove useful to future sportsmen, as well as some notes on the habitats and peculiarities of the big game of the province. The illustrations are fairly good, the best being the likeness of the author and his *fidus Achates*, Captain Percy Smith, in whose company the sporting tour was undertaken.

'Les regions Moï du sud Indo-Chinois. Le plateau du Darlac.' Par H. Maitre. (Paris: Plon. 1909. Pp. 335. *Map and Portrait.*) M. Maitre's travels and reconnaissances in this part of Indo-China were carried out between September, 1905, and June, 1908, and the Darlac plateau, which formed the special scene of his researches, lies about halfway between the Mekong river and the east coast. As a monograph, dealing with a very imperfectly known region, this little work may claim to be fairly exhaustive, but there is not much therein to interest the general reader, for the Moï, a name applied by the Annamites to the Annam highlanders, are only semi-civilized and not distinguished for any special arts or manufactures beyond the rude appliances and weapons pertaining to a race who subsist mainly by hunting.

'The Adventures of John Smith in Malaya, 1600–1605.' By A. Hale. (Leyden: Brill. 1909. Pp. 335. 10s. 6*d.*) This purports to be a narrative adapted from original notes by a trader in the East, who ended his days in Patani as the adopted son of the queen of that place. But as we are told at the outset that John Smith is not the signature on the letters and other documents, we are left to conjecture as to the actual origin and value of the story, which, however, affords no little entertainment.

'Ancient Tales and Folklore of Japan.' By R. Gordon Smith. (London: Black. 1908. Pp. xv., 361. *Illustrations.* 20s.) As the far Eastern empire is rapidly modernizing, it is well that such collections as this should be preserved, and this volume preserves one in attractive form. The illustrations are exceedingly clever.

AFRICA.

The South Central Sahara.

'Missions au Sahara.' Par MM. E.-F. Gautier et R. Chudeau. Tome ii. 'Sahara Soudanais.' Par R. Chudeau. Paris: Librairie Armand Colin. 1909. 83 *maps and text-figures*, 72 *plates.* 15 *fr.*

'Sahara Algérien,' the companion volume to M. Chudeau's work, was reviewed in the *Journal* for October, 1909, and some indication then given of the extremely valuable results obtained by the author of this volume and his colleague, M. Gautier. These are not books of travel. M. Chudeau, like M. Gautier, omits entirely any account of his wanderings, preferring rather to set forth systematically the results of his investigations. The part of the Sahara with which he is in the main concerned extends from the Ahaggar massif south to the Niger, east to Tibesti, and west to Mauratania. This includes not only the central regions where the Tuareg roam, but, along the Sudan frontier, that

> "Strip with herbage strown
> That just divides the desert from the sown."

The book is profoundly interesting. It appeals not alone to those whose concern is with geological, zoological, and allied problems, but to a much wider circle, including students of ancient civilizations and all connected with the development of the fertile regions of West Africa. M. Chudeau combats the belief, widely held, and with apparent reason, that the Sahara is encroaching upon the rich lands of the Sudan. Admitting recent instances of encroachment in the border zone, he maintains that a fuller examination of the evidence—notably that afforded by the ergs and the hydrographic system—will demonstrate, in all probability, that there has been no notable change in the area of the desert, merely an alteration in its position—that at an undetermined period of the Quarternary the Sahara must have occupied a more southerly situation than it does now. The present tendency is for the Sudan to encroach upon the Sahara. The author makes out a good case for his contention. The importance of the question as bearing on the future of Nigeria and French West Africa need not be insisted upon. A point made by M. Chudeau is, that in the border zone, notably in the region between the Niger and Zinder, land now barren would become fertile if cultivated. The security of tenure which should follow the establishment of French and British authority in that district may be expected to result in large areas becoming the homes of a sedentary population.

We have dealt with this subject first because of its bearing on the future of West Africa. Taking the chapters in order, the author begins with a sketch of the geological structure of the central regions of the Sahara, and then describes those regions in some detail—the Ahaggar (Hoggar), the Adrar of the Iforas, Adrar Tigirirt, and Air (Asbin). In the second chapter the same order is maintained in dealing with the border zone, which M. Chudeau calls "the high plains of the Sudan." Chapter iii. is devoted to meteorology, with the subdivisions climate and fog; chapter iv. to botany and zoology, including man. The three following chapters deal with the ancient hydrography, the fossil dunes, and various technical questions. It is impossible, within the limits of our space, to do more than indicate some striking points in the narrative, which is written with admirable lucidity. The account of the villages in the Ahaggar, where in an area one-fourth the size of France there is a population of some 6000, is to us quite new. These villages are not in oases, but are built on the sides of mountains nearly 7000 feet above the sea. The life of the Saharan farmers appears to be a hard one, but their numbers are slowly increasing. Several villages have been recently formed. The description of the fogs of the Sahara is vivid; besides the ordinary mirage-producing fog, dense fog is caused in the southern districts by the suspension in the air of impalpable particles of white clay. The grotesque shape often taken by these clay fogs is illustrated by several figures. The bold attempt to reconstruct the ancient hydrographic system can be outlined only in part. Its chief features are that (1) "The middle Niger seems to have had no past—it scarcely has a present;" (2) the Shari did not end in Lake Chad, but, by way of the Bahr-el-Ghazal, passed between Tibesti and Ennedi (Endi), and ended in some *shat* in the Libyan desert. That it may have reached the Nile is an hypothesis not absolutely rejected. With regard to the Niger, M. Chudeau shares M. Gautier's belief that the present upper river once ended in the Juf. At that time the river Taffassasset, coming from the southern versant of the Ahaggar and passing by Air, entered the Atlantic through what is now the lower Niger. The basin of Timbuktu was then (in the Quarternary age) a sea connected with the Atlantic; the sea in time became a closed lacustrine basin. The Juf having turned into a desert, the Niger was captured by the lakes and its course turned east; eventually the closed basin of Ansongo, which intervened between that of the Taffassasset and the new Niger, was breached and the

great river formed as we know it to-day. To follow M. Chudeau as he builds up his case is like following the plot of a detective story. It pieces together admirably.

In a chapter headed "Commerce," the author deals with the economic crisis caused in the Sahara by the suppression of the slave trade and the gradual supersession of its salt by cheaper stuff imported from Europe. The caravan trade to Timbuktu, he notes, has been killed by the competition of the Senegal-Niger railway; further east caravans can yet hold their own. A trans-Saharan railway, if ever built, must go towards Bornu to be of any economic value. In closing this inadequate notice, mention must be made of the many fine photographs given, the numerous plans and figures, and the coloured geological map. There is also an index (somewhat rudimentary, but welcome in a French work) to this and to M. Gautier's volume.

F. R. C.

'Le Cap de Bonne-Espérance au XVII^{e} Siècle.' By H. Dehérain. (Paris: Hachette. 1909. Pp. vi., 256. *Maps.* 3*fr.* 50 *c.*) The author of this volume has already made excursions into the history of the white man's settlement of Africa. He now traces the early history of the Cape from the first settlement by the Dutch. The work is full of detail, has copious references to original authorities, and must be an important contribution to the literature on the subject.

'South Africa' ("Romance of Empire" Series). By Ian D. Colvin. (London: Jack. 1909. Pp. xiii., 328. *Map and Illustrations.* 6*s.*) The nature of this series demands that the present volume should be less of a continuous history than a selection of events in which the element of romance is conspicuous. Nevertheless, it appears to be a more serious study of its subject than other volumes in the series which have come under notice. It is well written, with much lively imagery, which must stimulate interest in this hardly won part of the empire. The illustrations possess the same quality of imagination, perhaps less admirably exercised.

'Travels in the Upper Egyptian Deserts.' By A. E. P. Weigall. (Edinburgh: Blackwood. 1909. Pp. xiv., 193. *Illustrations.* 7*s.* 6*d.*) This is an interesting book, containing a sufficiency of travel narrative to attract the general reader, and some study of ancient sites set forth with an authority (the writer being chief inspector for the Department of Antiquities) which will commend it to antiquarians. The book is beautifully illustrated, and the author's descriptive passages are inspired with his intense admiration for the scenery of the desert. His book is to be commended to all who are interested in Egypt and its antiquities.

AMERICA.

The Conquest of Mexico.

'The True History of the Conquest of New Spain.' Vol. 1. By Bernal Diaz del Castillo, one of its Conquerors. Translated with Introduction and Notes by Alfred Percival Maudslay, M.A. London: Hakluyt Society. 1909.

The history of the exploits of Cortez in Mexico rests upon the narrative of Bernal Diaz, that stout old soldier, who described what he saw with absolute fidelity because he had not the wit or the literary skill to embellish his tale. His account of the expedition lay for many years in manuscript, and when at last it was printed in 1632, the editor, Friar Alonzo Remon, unblushingly mutilated the text by suppressing and altering important parts of the narrative. Fortunately, the original manuscript had been preserved among the municipal archives in Guatemala, and

Señor don Gerarro Garçia was able to print it verbatim. It is from this version that Mr. Maudslay has made his translation for the Hakluyt Society.

There was a peculiar fitness in the choice of a translator. Mr. Maudslay has spent the greater part of his life in the study of the archæology of Central America, and his identification of the places referred to in the text—particularly those now embraced by the modern city of Mexico—may be accepted without hesitation. Of the narrative itself it is enough to say that those who know their Prescott must not be content until they have read his principal authority, and that those who have read Bernal Diaz will not need to read Prescott at all, so vivid are the pictures, so instinct with the sense of romance is the story unfolded to us by this simple old soldier. Much of the effect depends upon the style of the translation, and so far as it is possible to embalm the spirit of sixteenth-century Spanish in modern English, Mr. Maudslay has succeeded to admiration. Take, for example, Diaz' artless description of the Mexican priests: "These priests wore black cloaks like cassocks, and long gowns reaching to their feet, and some had hoods like those worn by canons, and others had smaller hoods like those worn by Dominicans, and they wore their hair very long, down to the waist, with some even reaching down to the feet, covered with blood, and so matted together that it could not be separated; and their ears were cut to pieces by way of sacrifice, and they stank like sulphur, and they had another bad smell like carrion."

The present volume carries us to the point of the advance upon Mexico City after the Spaniards had sighted it from the heights of Popocatapetl. The most exciting part of the narrative is therefore still to come. The work, illustrated as it is with copious notes and coloured reproductions of ancient documents, is one of the most important ever issued by the Hakluyt Society.

B. T.

'Handbook of Alaska.' By Major-General A. W. Greely. (London: Fisher Unwin. 1909. Pp. xiii., 280. *Maps and Illustrations.* 8*s.* 6*d.*) This volume presents in compact form a guide to the physiography and economic conditions of Alaska. The author is well qualified for his subject, through both official connection with and wide travel in the country. Out of an interesting and valuable work one may select the study of volcanic phenomena (especially those of recent occurrence), and the author's strong views on the native question and the attitude of the Government towards it, as points worthy of special notice. The maps and illustrations are alike excellent.

'Stanford's Compendium of Geography and Travel. Central and South America.' Vol. 1 (second edition). By A. H. Keane; edited by Sir C. R. Markham. (London: Stanford. 1909. Pp. xxvi., 611. *Maps and Illustrations.* 15*s.*) A considerable amount of revision has been necessary to this new edition. Knowledge of the great untravelled areas of the South American continent (with which this volume deals) has been gradually extended; there have been several important frontier settlements, and so forth. The European colonies of the Guianas have, in this edition, been grouped with Central America, so that this volume deals exclusively with the independent republics. It bears the same evidence of careful arrangement and accuracy as the rest of the series.

'Chile: a Handbook compiled by the International Bureau of American Republics.' (Washington, D.C. [*N.d.*] Pp. 236. *Map and Illustrations.* $1.) This is a remarkably cheap volume at the price. It is very well got up, and its ten chapters treat systematically and comprehensively of the geography, climatology, biology, political and economic conditions of the country. The excellent

photographs illustrate equally well the scenery of the country and the high architectural standard of public buildings in some of the chief towns.

'A Trip into the Interior of Peru.' By the Rev. A. Miles Moss. (Lima: Southwell. 1909. Pp. 42, 120. *Map and Illustrations.*) This volume contains a brief text in English and Spanish, in the form of an amplified diary. But it is chiefly remarkable for its photographs, which fill the whole of the 120 pages in the second counting, and include numerous really beautiful landscapes and a number of interesting studies of Indian types. On p. 21 is a particularly fine example of bowed strata.

AUSTRALASIA AND PACIFIC ISLANDS.

Australian Meteorology.

Solar Physics Committee: 'A Discussion of Australian Meteorology.' By Dr. W. J. S. Lockyer. London: Wyman. 1909. 5*s*.

Under the above title a valuable contribution to meteorology has been made by Dr. J. S. Lockyer, of the Solar Physics Observatory. In a series of communications to the Royal Society, Dr. Lockyer and Sir Norman Lockyer have pointed out the existence of a barometric see-saw having a period of 3·8 years, and being of world-wide extent. It has also been shown that the pressure changes occurring from year to year in Australia are closely similar to those taking place in India, but that the mean amplitude of the Australian variation, amounting to nearly 35 per cent. of the mean annual variation, is nearly double that of the Indian change. Another pressure variation in operation in Australia takes about nineteen years to complete a cycle, and has an amplitude nearly 25 per cent. of the annual variation. These Australian pressure changes, being of such large amplitude, must play an important part in bringing about changes experienced in the weather from year to year.

Australian weather itself appears to be the product of a series of anticyclones moving west to east at an average rate of about 400 miles a day, and following one another with remarkable regularity. About forty-two pass over the continent in the course of a year, and the average time of transit over any place is given as 8·7 days. From a study of South American and South African records there is evidence that the anticyclones travel completely round the Earth as individual systems, although subject to local modifications. In the Australian summer months (October to March) the mean latitude of the paths of the anticyclones is about 37° to 38° S. During this time Southern Australia is more or less dry, the southern depressions being too far out at sea to bring much rain; whilst Northern Australia, lying during this season beneath the vertical sun, gets "monsoonal" rains. In the winter months (April to September), on the other hand, the mean latitude of the paths of the anticyclones is lower—about 29° to 32° S., with the result that while Northern Australia is usually dry, the southern portion of the continent coming under the influence of V-shaped depressions gets frequent rain. The low-pressure systems exhibit a tendency to wedge themselves in between the anticyclones both to the north and south. From the curves of twenty well-scattered stations it is found that the pressure changes occurring from year to year are general, and that simultaneous excess of high or low pressure in any one year is a marked feature of the whole of the Australian continent. Years of exceptionally high or low pressure in Australia are due to anomalies in the condition or movement of the anticyclones. Years of high atmospheric pressure are found from a study of curves to be years of low rainfall, and *vice versâ*; this is a natural, though by no means a necessary, relation. Years of high atmospheric pressure are characterized by an increased frequency of "southerly bursters." Not only does the rainfall

variation agree with the pressure variation as regards the 3·8-year cycle, but also to a fairly well-defined extent as regards the 19-year period. The changes of pressure occurring from year to year in Australia are closely related with those in India, which are the inverse of those taking place in South America. In connection with the barometric see-saw of 3·8 years, the two centres of inverse pressure type seem to be about Cordoba, in South America, and Bombay. The South American type of variation is closely associated with changes going on in the United States, Central America, North-West Africa, and Honolulu; whilst the Indian type is associated with those taking place in Europe, North-East and South Africa, Arabia, East Indies, and Australia. As regards the 19-year period, there is a time difference of phase amounting to about six years between South America and Australia. In other words, the Australian maxima do not, as in the case of the 3·8-year period, occur simultaneously with the South American minima. This fact may prove useful in long-period weather forecasting in Australia. The pressure curves for India reveal what has been discovered before, namely, that atmospheric pressure variation is related to the sun-spot period of eleven years, years of increased solar activity being years of reduced pressure in India consequent upon increased heat. It is, of course, just in large tropical countries like India that the direct effects of increased solar activity—increase of temperature causing decrease of pressure and increase of rainfall—will be manifested if anywhere. In higher latitudes any direct effects of increased solar activity are far more likely to be masked; for although an extra amount of heat from the sun must necessarily cause a differential rise of temperature over the whole Earth, nevertheless the net result in any particular region situated in a higher latitude might be, for instance, a cool summer in a sunspot year due to increased frequency of polar winds caused by the undue excess of temperature and deficit of pressure in lower latitudes.

L. C. W. B.

'The Dominion of New Zealand' ("All Red" Series). By Sir A. P. Douglas. (London: Pitman. 1909. Pp. xix., 444. *Map and Illustrations.* 7*s.* 6*d.*) This volume worthily upholds the promise of the series as regards matter, being attractively written and remarkably comprehensive. The map and the illustrations are quite good, but the binding and appearance of the book is less creditable, and some misprints may be detected.

POLAR REGIONS.

Baron Toll's Last Expedition.

'Die Russische Polarfahrt der *Sarja*, 1900-1902, aus den hinterlassenen Tagebüchern von Baron Eduard von Toll herausgegeben von Baronin Emmy von Toll.' Berlin: Druck und Verlag von Georg Reimer. 1909. Pp. 635. *Price* 14*m.*

In 1805, Sannikof, a mammoth bone collector, saw from the northern point of Kotelni island four mountains, and his observation was subsequently confirmed. The following year from New Siberia island he sighted another land towards the N.N.E., which was afterwards named by De Long Bennet Land. It was to establish beyond doubt the existence of these islands that Baron von Toll organized an expedition in a Norwegian whaler, refitted and re-named the *Zarya*. The chief results of his discoveries were published some years ago in this and other geographical publications, and this book is of interest as containing the detailed account of the progress of the expedition in the words of the leader and his companions. Passing through the Kara sea, the *Zarya* was frozen in at the end of September, 1900, in a small bay off Fram sound in lat. 76° 8′ 3″ and long. 95° 6′ 5″ E., whence sledge excursions were made to Taimyr bay, which proved to have only half the breadth

assigned to it by Nansen, and to be a typical fiord, and also to the Cheliuskin peninsula. The vessel was not released till August 25, 1901, and meeting with a contrary wind on the east coast of Taimyr, which Baron von Toll had wished to explore, was steered towards Bennet island, and Cape Emma, the south-western extremity of Bennet island, was sighted, but ice and fog prevented a closer approach. On September 24, 1901, the *Zarya* was frozen in for the second winter in Nerpalakh bay, on the west coast of Kotelni island, and in the beginning of June, Baron von Toll, accompanied by Seeberg, astronomer and magnetologist of the expedition, and two men, set out to travel to Bennet Land by sledge and boat. They were never seen again, but in August, 1903, Lieut. Kolchak visited Bennet Land and found there Baron von Toll's diary, a sketch-map of the island, and a description which has been already noticed in this *Journal*. Of this sketch and description, facsimile reproductions are appended to the volume. Baron Toll wrote that his party intended to set off southwards November 8, 1802, and as no traces of them have been found on the coast of Siberia or even in Franz Josef Land, it is to be concluded that they perished at sea. The scientific observations and biological collections are being worked up by various specialists, and some sections of the results are now ready for press.

In a concluding chapter, M. K. Vollossovich contributes a general survey of the scientific work of Baron Toll, and of the geological result of his last expedition. During his former visits to the New Siberia islands, Baron Toll had ascertained that they are geologically a continuation of the Verkhoyansk mountains, and in his last expedition he found they had many features in common with these mountains, but still more with the coast region west of the Lena. According to the accounts of Baron Toll and A. Kolchak, Bennet Land is a high plateau rising like a huge pillar from the waves. It is built up of older Cambrian and Lower Silurian strata with graptolites, and therefore appears to be a direct continuation of the central Siberian plateau. Basalts and liparites intersect the mass, the former covering coal-bearing slates similar to those found in New Siberia, and the liparite is identical with that on the Balytakh, so that it cannot be of later than Pliocene age, and probably these latest eruptive rocks of Siberia may be assigned to the end of the Tertiary period, and it may be assumed that the tremendous vertical disturbances of the continent during this period contributed to the glaciation of the ocean by cutting off warm equatorial currents.

GENERAL.

Stanley's Autobiography.

'The Autobiography of Sir Henry Morton Stanley, G.C.B.' Edited by his wife, Dorothy Stanley. Sampson Low, Marston & Co. 1909. 21*s. net.*

This is probably the most interesting book that Stanley ever wrote, so far as all the purely autobiographical portion of the book is concerned—in other words, more than three-quarters of the work under review. There is no question of "wading" through this book; one flies through it, and returns to read and re-read the more vivid portions. And here it must be said that Lady Stanley has done her editing in the most judicious and catholic manner possible. She never once stands between Stanley and the reader, but assumes rather the attitude of an attendant at the side of the proscenium who from time to time raises and lowers the curtain.

Perhaps the book is not very appropriate for review in the pages of the *Geographical Journal*, as it may seem at first that the geography in it is already known or is out of date, and that Stanley in his last great work has been able to add but little to the enormous score he had already piled up of geographical revelations. But perhaps because Stanley was twice a medallist of the Royal Geographical

Society, members of that body may, by reading this book, care to know more than they have ever known before about this remarkable Welshman, the St. George who gave the *coup de grâce* to the Dragon of African obscurity. As we recede more and more from the perspective of the nineteenth century, so Stanley's figure will rise in proportion higher and higher amongst the crowd of nineteenth-century heroes. The more we come to know Africa, the more we shall be penetrated with a sense of the unique courage and determination which enabled this man to do what at that time was inconceivably difficult—to pierce a way down the unknown Congo, past the long course of rapids known as the Stanley falls, to navigate 1000 miles of unknown, cannibal-dominated river, and emerge again after an even more trying 100 miles of cataracts into the long estuary of the Congo.

The autobiography covering Stanley's life, from his first hours of consciousness in a cottage facing Denbigh castle to his starting on the search for Livingstone, deserves to take rank with 'Gil Blas,' with Dana's 'Before the Mast,' Mark Twain's 'Tom Sawyer' and 'Huckleberry Finn,' and some of Dickens's work, with here and there a Rabelaisian touch, which, however, has nothing nasty about it. The description of New Orleans in the fifties of the last century is a pen-picture of crudities written by a pure-minded person. Stanley's descriptions of the actual fighting between the Northern and the Southern forces (he was impressed as a volunteer on behalf of the South, and then several years afterwards served in the marine of the North) is one of the most graphic descriptions the reviewer has ever read of an actual battle in more or less modern times between contending white men. Equally graphic, but more horrible, is the description of the prisoners' camp near Chicago, in which the wretched war-captives rotted away by hundreds with preventable disease (though Stanley is careful to point out that prisoners taken from the Northern army suffered equal horrors in their Southern captivity). It was still an ignorant and a fierce-minded time, though there is many a touch of tenderness, and even sweetness, given in his pen-portraits of the American soldiers in both armies.

His descriptions of Livingstone [added to his original work on that subject by reference to note-books and conversations] are of the greatest interest, and almost deserve to be gathered up and printed separately as a kind of addition to the extant biographies of Livingstone.

Yet to those who expected no more staggering revelations of African wonders the book is of great geographical interest, as it teems with excellent and graphic descriptions of countries so well known that they have never been properly described. The writer of this review appreciates to the full the continual word-pictures given by Stanley (from memory) of the scenery of the Southern States of America, through which he passed as a soldier in the "Dixie Greys." He noted the dreamy and the sumptuously beautiful pine forests found in the relatively flat lands which lie between the great Alleghany chain of mountains on the north and the swampy semi-tropical country along the southern seaboard; he bows his head before the majesty of the 200-feet-high magnolias, and revels in the blaze of colour from the autumn foliage of liquidambars, live oaks, maples, and hickories. If he could be recalled and questioned, he would probably agree that some of the loveliest scenery of the United States may be located in Arkansas, in Eastern Texas, in Louisiana, Alabama above all, Southern Georgia, and Northern Florida.

Here is an impression, jotted down some time after he had come to rest in England, of the river Severn: "I saw the largest river in England yesterday; it appeared to be a little wider than what I could hop over with a pole in my best days. It was a dirty, rusty-coloured stream, but the meadows were fat. The country seems to perspire under its covering of leafy verdure. I always loved the

English country, and my secret attachment for it seemed to me well confirmed to-day as I thrilled with admiration and affection for all I saw. . . . On reaching London, compare the sad-looking streets which you look down upon from the lofty railway with the bright Paris you left in the morning. You may compare the one to a weeping widow, the other to a gay bride; or to a slatternly fish-woman and a neat grisette. . . . France and Italy shine with whiteness, Britain appears in a half cleaned-up state after being drenched with soot; its sky seems more threatening, and though the leafage and grass and the trees are pleasantly green, the stems and twigs are exceedingly black. The white cottages with red tiles of France are more beautiful than the dingy brick and dark slate of England."

There is an interesting statement on p. 538 of what Stanley would have done had he been in Gordon's place in 1884. "I would have lived, if only to get the better of the Mahdi; with joy of striving and fierce delight of thwarting, I should have dogged and harassed the Mahdi like Nemesis till I had him down." He would, in short, either have retreated whilst there was time to Berber, or have forestalled Emin Pasha by carrying himself and the pick of his garrison in his steamers up the Nile to the equatorial regions, whence he would easily have got in touch with Great Britain through Uganda. There is also a passage on p. 537 which gives his opinion on the trend of the Congo Government since the early nineties.

H. H. JOHNSTON.

TEXT-BOOKS.

'The Oxford Geographies.' Edited by A. J. Herbertson. (Oxford: Clarendon Press. 1909.) (*a*) 'The Elementary Geography,' vol. 1. 'A First Physiography.' By F. D. Herbertson, B.A. (Pp. 79. 13 *Illustrations*. 10*d*.) Great care has been used in putting the matter into suitable form, and the illustrations are admirably chosen. The book should be stimulating to teachers who have to teach young children. It is doubtful if it could be put into the hands of children who could not already read fluently, for some of the ideas are advanced. The same criticism applies to the excellent illustrations, which require an examination and analysis few children would be capable of giving. In the hands of an able teacher, much could be accomplished in preparatory forms of schools of the higher grade.

(*b*) The same. Vol. 2. 'In and about our Islands.' (Pp. 112. 1s.) Vol. 3. 'Europe.' (Pp. 111. *Illustrations and Maps*. 1s.) By the same author. These volumes have all the merits of vol. 1, and, with the exercises which are essential to their successful use, make excellent text-books. One wonders why the structure of Europe as a whole receives no separate treatment, since vol. 3 presents the first continental study in this series, and would be taken about two years after vol. 1. Further, a suggestion that North America be the first continent studied, which appears to be made by the arrangement of the subject-matter in 'The Preliminary Geography,' is not upheld in this series, which has apparently the same source.

(*c*) 'The Practical Geography.' Part II. By J. F. Unstead. (Pp. 112. 1s. 6*d*.) A very useful collection of exercises of a more advanced kind. The exercises devoted to the principal countries will serve to give a reality to the statements of any text-book, and the suggestive comparative exercises should result in further recourse to annually published statistics. For such work a teacher might divide a class into groups to deal with different sets of figures relating to a region. The results should be gathered up in a general report at which the whole class is present. Care should be taken to guard against the exercise being the sole end in view instead of illustrating some topic of the geographical course on which the class is engaged.

'Practical Modern Geographies.' Macmillan & Co. 1909. (*a*) 'Practical Exercises in Geography.' By B. C. Wallis. (2*s*. 6*d*.) A useful collection of practical exercises and examination questions, with many tables, graphs, diagrams, and pictures from which a teacher might well make a selection. The author has used the book as it is for a two years' course, centred apparently round the British Isles and the North Atlantic ocean respectively.

(*b*) 'A Geography of the British Isles.' By A. Morley Davies. (3*s*.) Emphasizes the importance, as far as possible, of first-hand evidence in the class-room, and endeavours to impress the importance of the two natural methods of land division by river-basins and by geological formations. The aim is well carried out, and the book is recommended to teachers interested in such a method, which makes for self-reliance on the part of the children.

'A General Geography of the World.' By Henry E. Evans, B.A. (Blackie & Son. 1909. Pp. 414. *Index and Appendices*. 3*s*. 6*d*.) A book full of facts collected for preparation for examinations. No light task is involved in its compilation, and it fully needs the amplification the author suggests.

'The New Outlook Geography.' (Harrap & Co. 1909. 1*s*. 6*d*.) Book i., "How People Live." By W. C. Brown and C. H. Johnson. The authors have endeavoured to frame a first text-book for town schools for boys of nine to eleven. The book might well find a place in such schools, for it is suggestive in method, and unsuitable exercises or questions can be omitted, as they are subsidiary to the main issue—geography from the human standpoint first.

'A Scientific Geography.' Book vii. "British Empire." By Ellis W. Heaton, B.SC., F.G.S. (London: Ralph, Holland & Co. 1909. Pp. 243. 2*s*. *net*.) Others of this series have already been noticed in the *Journal*. The arrangement of this, the last, volume necessitates much repetition which needs suppression, and it is unfortunate that the districts should receive two somewhat incomplete treatments, for it is not likely to aid the student in the preparation for the examinations for which the book is written. Some obvious "printer's errors" have been passed, and the treatment of climatic factors is in places not too clear. In the maps and diagrams lies the real merit of the book for examination purposes, and the author may have intended the text to merely supplement these. Reference to other volumes is a doubtful method of treating fundamental principles, and inadequate in the case of "The British Isles," unless a statement to that effect is included in the title. To treat of the British Empire in a volume of this size and type is a most difficult undertaking, which the above remarks emphasize without denying a considerable ability to the attempt.

'The British Isles. Practical and Economic Geography. By C. A. Wood, M.A., F.G.S. (London: The Normal Press. 1909. 1*s*. 6*d*. *net*.) This book is a summary of statistics and geographical facts for examination purposes. The diagrams and maps are devised to this end. Some revision is needed, particularly in the section dealing with railways. Much information is compressed within a small compass.

'Africa and Australia.' By Miss J. B. Reynolds. (A. & C. Black. Pp. 128. 81 *Maps, Diagrams, and Illustrations*. 2*s*.) The text is clear, and with the illustrations gives a concise account, based upon good methods of classification, of the subject-matter. It should be most useful as a first text-book leading to a comparison of these two southern land masses where it applies.

F. G. A.

'A Modern Geography for Irish Intermediate Schools.' By J. H. Cousins. (Dublin: Maunsell. 1909. Pp. xiv., 158. *Maps and Diagrams*. 1*s*. 6*d*.) This is a geography of the world, but, being designed for Irish uses, it deals with that country

in some detail. In style it is pleasantly free from the oppressiveness characteristic of many school geographies, and, while possessing no distinguishing features, its matter seems sound and well arranged. The sketch-maps and diagrams are of poor appearance, and some are almost too rough and generalized to be of value.

'A Systematic Geography of the British Isles.' By G. W. Webb. (London: Methuen. 1909. Pp. viii., 94. *Maps and Diagrams.* 1*s.*) This is the first volume of a series of five which is to cover the whole world. Its aim is "to present in a clear and logical manner the salient points in the geography of the British Isles." It does so in a rather formal and tabular manner, which could hardly but repel the student if he were dependent on this volume alone; but if read in conjunction with other branches of geographical study of greater natural interest, it should prove useful.

'By Road and River.' By E. M. Wilmot-Buxton. (London: Methuen. 1909. Pp. viii., 154. *Maps and Illustrations.* 2*s.*) In view of the title, the sub-title of this book is somewhat unexpected—'A Descriptive Geography of the British Isles.' It is an attempt, and should be a successful attempt, to render geography palatable by guiding the learner on imaginary journeys through his own land. The use of such a method within so small a compass makes the text somewhat "sketchy," but all the information given is worth having. The maps are above the average.

'A Scientific Geography. Book vi. Asia.' By Ellis W. Heaton. (London: Ralph, Holland. 1909. Pp. 148. *Maps and Diagrams.* 1*s.* 6*d.*) We have here another volume of concentrated geographical teaching, but the author fortunately does not err in the direction of tabulation or other forbidding features which are common in such works. His style ought not to fail to interest the student, and the information contained in the volume is comprehensive. An index is lacking.

O. J. R. H.

THE MONTHLY RECORD.

EUROPE.

The Purpose of Deneholes.—The Rev. J. W. Hayes contributes a lengthy article to the *Journal of the Royal Anthropological Institute* (vol **39**, p. 44, 1909) on the subject of deneholes in the home counties and elsewhere, and considers the evidence in support of the large number of theories that have been advanced to account for their existence. The etymology of the word "dene" indicates its derivation from an Anglo-Saxon word signifying a depression, cave, den, or hole, "dene" being used with "hole," as a double name, in the same way as "river" is used with "Avon" and "Ouse," both of which words signify river or running water. Of ten theories concerning the purposes of deneholes struggling for recognition there is only one, according to Mr. Hayes, which satisfies the laws of evidence, and that is that these excavations are simply "chalk pits," "chalk wells," or "chalk quarries," and not granaries, hiding-places, burial-places, etc. The fact of chalk being dug for, often through 60 feet of superimposed strata, instead of being quarried at the surface in chalky districts, need cause no wonder, inasmuch as surface chalk is impure and unfit for building-blocks or for making lime, whereas good block chalk in a dense pure condition is best obtained under great masses of sand, such as are found at Hangman's Wood, Abbey Wood, Bexley, Swanscombe, Purfleet Hill, and various other places. As for the Chislehurst caves, they may be old, but there is nothing to favour the view of their mysterious origin. They are simply old chalk workings. The evidence of men who have worked in the caves goes to show that half a

century ago chalk was still extensively obtained from these workings, and used by farmers as a dressing or manure for poor soils in the days when manure was scarcer than now, and the demand for chalk dressing proportionately greater.

Navigation of the Rhone.—An article by P. Frécon in the *Bulletin de la Société de Géographie de Lyon* (2e Série, 1909) discusses the question of the navigation of the Rhone and the project of a lateral canal. Admitting the desirability of an increase in the ways of communication in the Rhone valley, the writer does not look for a revolution in the economics of France from its realization. Comparing, too, the costs and services of water- and rail-way respectively, he decidedly prefers the latter, and notes methods of utilizing the Rhone, independent of navigation. Since the latter half of last century, the Rhone is one of the best navigable highways of Europe. Whereas it has almost always a minimum depth of 4·6 feet, the Elbe has this for 200 days, the Vistula for 155, the Oder for 127 only. The total tonnage floated by the Rhone amounts to 300,000 as against 440,000, exclusive of coals, circulating in the waterways between the English channel, the Belgian canals, and Paris. The volume of the Rhone-borne trade can never, however, by any engineering application, compete with that of the Rhine-borne trade, seeing the agricultural valley of the Rhone is not to be transformed into an industrial valley. The rivalry of Genoa is not due to its better communications. The St. Gotthard tunnel wrested much trade from Marseilles, and now the St. Gotthard, in turn, is suffering from the competition of the Simplon. A tendency to shift eastwards is notable in the current of international traffic. Genoa and Brindisi are in their turn threatened by Saloniki. Busied with the advancement of her communications with Macedonia, Austria-Hungary recognizes how the improvement of this port would attract to its lines the traffic of Central Europe. The north of France should gain from the opening of the Simplon; its more westerly position, as compared with the St. Gotthard, gives France the opportunity of recovering part of the merchandise and passengers lately diverted elsewhere.

A Morphological Study in Württemberg.—A recent issue of the *Forschungen zur Deutschen Landes- und Volkskunde* (**18**, Heft 4) presents an interesting study of the physical development of the step-landscape, by which the Swabian Alb falls in a north-westerly direction towards the basin of the Neckar in Württemberg. It is shown that, according to the now accepted ideas, this, like other step-landscapes, has been formed out of an original peneplain by the action of running water. The various stages in the development of the existing river-system are clearly traced by the author, who uses the terminology of Prof. W. M. Davis, and illustrates the processes by block diagrams such as have been used with so much effect by the latter writer, as well as by a map giving a diagrammatic view of the succession of steps. Various modifications of the drainage have taken place in the course of ages. The original consequent streams had a slope from north to south, cutting through the escarpments of the Lias and the White Jura formed by the action of their subsequent tributaries. Down to the deposit of the diluvium the district was drained by the Kocher and Jagst (now tributaries of the Neckar) towards the Danube, the water-parting coinciding roughly with the escarpment of the Keuper, the most northern of the three steps. Later, as a result of tectonic disturbances and the lowering of the base-level of erosion on the lower Neckar, a series of stream captures took place, the Jagst first overflowing into the Hohenlohe plain, while the Rems, Murr, Kocher, and Bühler were also in time diverted towards the Neckar. The old subsequent valleys are thus now drained in an inverse direction, and the map clearly shows how many of the minor tributary valleys, which have retained their primitive direction, point backwards towards the sources of the larger streams.

The Disaster to the Von Knebel Expedition in Iceland, July, 1907.—The tragic disappearance of Prof. von Knebel and his companion Rudloff, during an expedition to the Askja volcano in Iceland (*Journal*, vol. **30**, p. 436) is still more or less of a mystery, but an attempt is made by Herr Krebs (*Deutsche Rundschau für Geographie*, vol. **31**, part 12) to account for it as the result of a catastrophe brought about by seismic-volcanic disturbance. The writer points out that a world-shaking earthquake of some magnitude was recorded at European seismological stations on the very day (July 10) on which the disaster occurred. The area of maximum shock is placed somewhere in the region of the Philippine islands, and it is pointed out as a remarkable fact that in March, 1875, simultaneously with the greatest eruption of Askja known within historic times (an explosion comparable to that of Krakatau in 1883), a large area, also lying almost antipodal to Iceland, was similarly affected by severe seismic and volcanic disturbances. The neighbourhood of Iceland is, in fact, known to have been specially liable to such disturbances in July, 1907, for only two days before the catastrophe of the 10th the cable to Iceland had been broken—for the first time, apparently, since it had been laid down. The suggestion therefore is that, as a result of some seismic or volcanic disturbance, a landslip occurred on the precipitous shores of the Askja lake, by which the two German travellers (known to have been then navigating the lake) were overwhelmed. A similar explanation, though not based on the same line of reasoning, was suggested by Herr Erkes, the geologist who visited the scene of the disaster in 1908.

Hydrological Research in Italy.—An important organization for the collection and utilization of hydrological observations has lately been set on foot in Northern Italy, with Venice as its headquarters. By an Act passed on May 5, 1907, a special office was constituted, under the title "Magistrato alle Acque," with the task of generally supervising the waters of North-Eastern Italy and regulating them in the interests of forestry, hydraulic works, harbours, etc. The area under its control embraces the whole Venetian territory with a portion of the adjoining province of Mantua in Lombardy. The hydrological conditions within this area are somewhat exceptional, by reason of the torrential character of the rivers, which, descending rapidly from the mountains to the plain, being fed by a copious rainfall, and possessing no natural basins to regularize their flow, occasion frequent and disastrous floods. In order to create the organization necessary to carry out the proposed task, an "Ufficio Idrografico" was formed, and this issued its first annual report during 1909. The first step was the creation of five separate "services," dealing respectively with meteorology, rainfall observations, hydrometry, the prevision of floods, and tide-observations. The meteorological observatories already existing within the area have come into line with the new organization, and a scheme has been prepared for the correlation and systematization of the observations made throughout the area, under the direction of the observatory of the Patriarchal Seminary at Venice. Complete rainfall observations being of special importance for the objects in view, no fewer than 290 places have been selected as observing stations, the average distribution being at the rate of one to every 90 square kilometres of surface—a mean density which is certainly one of the highest in Europe. This is rendered advisable by the special conditions and the great variations of rainfall within the area dealt with. The hydrometric service will extend and systematize the measurements made in the past on various rivers, and three classes of observing stations will be maintained, according as the object is the prevision or regulation of floods, or merely the supply of a regular hydrometric record. Lastly, the Tidal Service will take over all the instruments and other equipment of the organization lately started by the Reale Istituto Veneto

for the study of the lagoon of Venice (cf. *Journal*, vol. **27**, p. 298), and will carry on a series of tidal observations, both on the outer coast and within the various lagoons. The work thus undertaken will be of great practical importance, and it is to be wished that the excellent example thus set might be widely followed.

AFRICA.

Terrestrial Refraction at Alexandria.—In the *Cairo Scientific Journal* Mr. C. Xydis gives the results of measurements upon terrestrial (atmospheric) refraction made by him at Ibrahimia. The measurements were obtained by making observations of the dip of the horizon from the terrace of his house, which is distant from the seashore 205 metres on the north and 320 on the west, the greater part of the line of sight thus lying over the sea. The altitude of the theodolite used was 20·68 metres, and the distance of the horizon thus approximately 17·5 kilometres. The range of the tide at Ibrahimia is about 60 centimetres, and this necessitates a correction of the calculated dip of the horizon for the tidal effect of $\pm 4''$, it being assumed that the rise of the tide on the open sea is the same as on the seashore. The true dip is given by the formula—

$$D_{true} = \text{cosec } 1'' \, (2h/R)^{\frac{1}{2}}$$

where D is the dip of the true horizon in seconds, h the altitude above the level of the sea, R the radius of curvature of the meridian for latitude 31° 13′, which is 6,352,300 metres with Clarke's figure of the Earth. The apparent horizon is approximately represented by the formula—

$$D_{app.} = \text{cosec } 1'' \, [2h(1-k)/R]^{\frac{1}{2}}$$

where k is the coefficient of refraction. From the measured dip of the horizon the value of k is derived, since all the other quantities are known. The following conclusions are drawn by Mr. Xydis from observations carried out in October, November, December, and January: (1) k is an almost constant quantity from 8 or 9 a.m. to 4 or 5 p.m.; (2) the refraction is practically the same, so far as the observations go, in both the observed directions (north and west); (3) k, which is usually positive, is at Ibrahimia in many cases negative, signifying that the line of sight is made convex downwards by the refractive action of the air. The usual of k was about 0·08, but during the khamsin days in February and March its value ranged from 0·40 to 0·58, represented by dips from 6′ 46″ to 5′ 5″. Mr. Xydis explains the small dips on khamsin days by the fact that on such occasions the air in contact with the sea is cooler—making the curve of the ray of light flatter than is usually the case. On five occasions a dip of the horizon of about 8′ 25″ at 1 p.m. was followed by either strong north-west wind or khamsin. In Egypt the refraction varies more than in European countries, and the physical explanation of the variability of k, found by Mr. Xydis, is to be sought in the rapid variation of the temperature gradient in the lowest strata of the atmosphere through which the line of sight passes.

Ptolemy's Knowledge of West Africa.—We have received from Captain R. Avelot the reprint of a paper contributed by him to the *Bulletin de Géographie Historique et Descriptive* (Nos. 1 and 2, 1908), under the title "L'Afrique Occidentale au temps des Antonins" (Paris, 1909). The writer justifies yet another disquisition on Ptolemy's geography on the ground that recent research in the Western Sudan, especially that of Lieut. Desplagnes as set forth in his book 'Le Plateau Central Nigérien' (cf. *Journal*, vol. **30**, p. 550), has for the first time supplied the necessary facts in regard to the region in question. He holds that there is ground for believing that the knowledge of the countries south of the Atlas

possessed by the Romans in the time of the Antonines was far more extensive than has sometimes been supposed, such knowledge being gained, not directly, but through the intermediary of enlightened natives. He examines in turn Ptolemy's nomenclature of the coast-line and the interior, and his accounts of the tribes of West Africa, endeavouring in each case to explain his statements by the aid of existing knowledge. The result is, in his view, to prove that the acquaintance of the Romans with West African geography and ethnology extended as far as a line running approximately from Sherbro island on the Atlantic to Say on the Niger. It cannot be denied that the identifications are generally such as to win confidence, and that a satisfactory agreement seems capable of being made out between Ptolemy's statements and the reality. Captain Avelot wisely abstains from basing arguments on mere similarity of names, though such similarity is often used as an additional support of conclusions arrived at on independent grounds. Thus the *Darad* (identified by C. Müller with the Draa) coincides, according to Captain Avelot's scheme, with the Senegal, and it is pointed out that the Wolofs of the present day know this river as the Ddar. Of other names mentioned in connection with the coast, Cape *Arsinarion* is Cape Verde, the *Nia*, the Gambia (a hill at the source of which is still known as Nia-kwa—"head of the Nia"), and so on. As regards the interior, the much-discussed question of the Nigir and its branches receives a new solution, its upper course being identified with an old drainage system now buried under the sands of the Sahara, but which is held to have formerly descended from the western Adrar towards the lacustrine basin of the Niger west of Timbuktu. Of the three great nations mentioned by Ptolemy in the northern part of the region, the "Black Getulians" were a branch of the Berbers of the west, "black" signifying merely that they belonged to the confederacy of which black was the national colour. The "Red Ethiopians" may well have been the Fulas, as has been generally thought, though the confederacy of the Reds included a great number of tribes. The "Ethiopians of the Nigir" (not black Ethiopians, which would have been a tautology) are considered to have been a congeries of Mandingo tribes. In accordance with these conclusions, Captain Avelot supposes that, except on the coast, where the Berbers reached down to the Senegal, the Negro domain extended much further north in Ptolemy's time than at the present day.

A Search for the "Bushmen's Paradise," German South-West Africa.—A minor piece of exploration of an interesting character was performed last February by Lieut. Trenk, who, encouraged by the favourable rainfall, set out from Sesrim (in the valley of the Tsaukhab, south of the Khuiseb) in search of the reported vley of Sossus, with which has been connected the legend of a "Bushmen's Paradise" in this part of the country (*Deutsches Kolonialblatt*, September 1, 1909). All attempts to reach Sossus had previously failed. The route led west down the dry valley of the Tsaukhab, which, after traversing a narrow gorge with perpendicular sides, widened out somewhat, and entered the belt of sand-dunes which here run regularly from north-west to south-east. The valley must once have been well covered by trees, which (now dead, except in the actual bed of the river) occupy most of its width for over 20 miles from Sesrim. Grass continued to occupy the river-bed for some miles further, but vegetation then entirely ceased until, on reaching Sossus, a number of green trees and bushes were found to cover the western side of a large vley, beyond which the river's course was entirely blocked by dunes. No water was to be seen, the bushmen fetching their supply from a point 12 miles up the river, or obtaining the necessary liquid from the succulent Nara plant (cf. *Journal*, vol. **32**, p. 336). Between the dunes, the valley of the Tsaukhab is formed of the hard stony ground known as "Namib."

AMERICA.

Captain Bernier's Expedition in the Canadian Arctic Archipelago.—We have received a copy of the *Citizen* of Ottawa, October 18, 1909, containing the account of Captain Bernier's entertainment at luncheon by the Canadian Club on October 16, after his return from his northern voyage. From this it appears that the *Arctic* (formerly the *Gauss*) wintered on the coast of Melville island, which Captain Bernier described as a beautiful island, with thousands of musk-ox and reindeer, as well as wolves, foxes, and some bears and seals. The climate was wonderfully dry, and from April to July there was abundance of grass and flowers. He took the *Arctic* some 10 miles further, and then saw open water for another 20 miles, so that it would have been perfectly feasible to complete the north-west passage once more. The records left by Sir Edward Parry were found and brought back, as was also a pole used by Sir John Franklin. McClure's depôt was found despoiled of everything except some pieces of canvas and some coal. Formal possession of the whole archipelago, from 60° to 141° W., and up to 90° N., was taken, and this was recorded on a copper plate erected at the winter harbour on Melville island. Sir Wilfrid Laurier, who was present at the luncheon, expressed the hope that Captain Bernier would be ready to start again in 1910 with the same ship and crew, and promised that a free hand would be given him to go to whatever latitude he found possible.

Lake Ramparts in Minnesota.—We referred, in the *Journal* for August, 1908 (vol. **32**, p. 390), to Prof. Gilbert's discussion of the ramparts on lake-shores formed by the action of ice in pushing up the stones, etc., from the outer portion of the bottom. Attention has since been called, in a paper by Mr. R. F. Griggs in the *American Journal of Science* (May, 1909), to the frequent occurrence in Western Minnesota of lakes cut up into two or more portions by similar ramparts, forming long narrow barriers, sometimes extending from shore to shore. Reasons are given for believing that such barriers can have been formed by no other agent than ice, though it is allowed that its action can hardly have come into play unless there were shallow places in the beginning. Where lakes of large size have been divided by such barriers, the original irregularities may have been caused by lines of moraine crossing them. In many cases the barriers merely cut off small ponds or swamps by forming across shallow bays, and these can be accounted for by ice-action alone. Thus the final result is to accelerate the filling up the lake by the growth of vegetation in the shallow water, though primarily the tendency of the ice-pressure is to clean out the advancing vegetation and pile up steep banks. The remarkable character of the barriers described is well shown by photographs.

The Mapping of Colombia.—We have been favoured with the copy of a communication received at the Foreign Office, relating to the recent establishment of an "Office of Longitudes" at Bogotà. The office, which was created by Law No. 30, of 1909, dated October 11, and is placed under the Ministry of Foreign Affairs, is described as "a scientific centre for the systematic and progressive improvement of the general map of the Republic." It is provided that the National Astronomical Observatory shall give its assistance in connection with meridians which can be obtained by telegraph, in order that these may be referred to the meridian of the Observatory; the free use of the telegraph being accorded for this purpose. The instruments and other apparatus used by the Venezuelan Boundary Commission are to be handed over for the use of the new office. This new departure is a welcome step towards the provision of a trustworthy map of Colombia.

AUSTRALASIA AND PACIFIC ISLANDS.

Soundings by the "Planet" in the Western Pacific.—The work of the German Survey ship *Planet* has been continued during 1909, and besides the soundings in the neighbourhood of Bougainville referred to in the *Journal* for July last (vol. 34, p. 91), various other series have been obtained in the portion of the Western Pacific adjoining the German possessions in that region (*Annalen der Hydrographie*, 1909, Heft 8). Another sounding of over 6000 metres was obtained to the west of Bougainville, but as a part of the sounding-line, with the instrument attached, was lost, the exact depth was not ascertained. A number of soundings east of the Solomon islands show that the depth here is comparatively small, though the existence of a deeper channel of about 3000 metres between the islands and the reefs to the east seems established. The slight depths *between* the islands seem to point to their former connection, a state of things which contrasts with that in some of the Pacific groups, *e.g.* the Marshall islands. Among the later soundings was one of 7406 metres only 20 nautical miles to the south of New Pomerania (New Britain). This seems to confirm the existence of a very deep trough running from the west coast of Bougainville towards the south coast of New Pomerania.

The Rainfall of New Caledonia.—The above subject is dealt with in a pamphlet by Messrs. T. Mialaret and A. Fraysse, entitled 'Contribution à L'Étude du Climat de la Nouvelle-Caledonie' (La Pluie de 1903 à 1908). It is regrettable that meteorological observations for a long series of years (1860–1903) only exist for one station in the island, namely Noumea, inasmuch as differences of altitude and exposure cause considerable local variation of climate. So far as can be judged from five-year observations, there is much more rain on the east coast of the island than on the west. At Nouméa the rainy season begins about January, when the sun, after having reached its most southerly declination in December, again becomes vertical over the island, but, as in many tropical countries, there are large variations of rainfall from year to year. Torrential rainfalls are, as might be expected, of somewhat frequent occurrence, and the heaviest fall in twenty-four hours at Nouméa occurred on April 5, 1872, when 242·5 millimetres (9·5 inches) fell during a tempest. Although there is great mineral wealth in Caledonia, the prosperity of the colony must depend mainly upon agriculture, to which the warm climate, without extremes of temperature, and abundant rainfall, averaging about a metre (40 inches) a year, is eminently favourable. As is the case, however, with many of the Pacific islands, especially those parts of them sheltered by mountains from the action of trade winds, New Caledonia is liable to periods of drought which are very prejudicial to the interests of agriculture. The island of Hawai near the northern tropic is nearly symmetrically situated with regard to New Caledonia near the southern tropic, and although the rainfall is less than in New Caledonia, the effects of drought have been neutralized by a successful system of irrigation. Authorities consider that natural conditions favour irrigation work in New Caledonia also, and that it is a question of money whether the work can be undertaken.

POLAR REGIONS.

Honour to Commander Peary: Report on his Observations.—At the meeting of the National Geographic Society of Washington on December 15, a medal was awarded to Commander Peary for his attainment of the North Pole, and also a medal to Captain Bartlett, who, it will be remembered, accompanied him as far as 88° N. lat. The following Report of the Sub-Committee of the Research Committee of the National Geographic Society, on the Peary Expedition, has been forwarded to the Council by the Secretary of that Society: "The Sub-Committee

to which was referred the task of examining the records of Commander Peary in evidence of his having reached the North Pole beg to report that they have completed their task. Commander Peary has submitted to this Sub-Committee his original journal and records of observations, together with all of his instruments and apparatus and certain of the most important of the scientific results of his expedition. These have been carefully examined by your Sub-Committee, and they are unanimously of the opinion that Commander Peary reached the North Pole on April 6, 1909. They also feel warranted in stating that the organization, planning, and management of the expedition, its complete success and its scientific results, reflect the greatest credit on the ability of Commander Robert E. Peary, and render him worthy of the highest honours that the National Geographic Society can bestow upon him.—HENRY GANNETT, C. M. CHESTER, O. H. TITTMANN, Sub-Committee, Research Committee."

Captain Scott's Antarctic Expedition.—We are pleased to learn that progress continues to be made with the organization of Captain Scott's proposed South Polar Expedition. Dr. A. E. Wilson will once more accompany his old commander, occupying the position of chief of the scientific staff, with the special *rôle* of zoologist and artist. Among the three geologists who will, it is hoped, take part in the expedition is Dr. J. Mackintosh Bell, whose excellent work both on the Canadian Geological Survey and, more recently, as Director of the Geological Survey of New Zealand, is well known. Dr. Bell has volunteered his services, and will accompany the expedition if he obtains the necessary leave. Of the two physicists, one will be Dr. R. Simpson, of the Indian Survey Department, who is now on his way to England from India. Biology will be looked after by two if not three experts (who will be chosen for the special reference to their knowledge of marine biology), while a second doctor will share with Dr. Wilson the medical care of the party, besides undertaking research in botany and bacteriology. Another member of the expedition will be Mr. C. H. Meares, the late Mr. Brooke's companion during a part of his journeys in Western China (cf. Mr. Meares' article in the December number, p. 614). He will shortly leave England for Eastern Siberia in order to collect the necessary ponies and dogs, which will be sent from Vladivostok *viâ* Kobe to New Zealand, where Mr. Meares will himself join the expedition. Captain Scott gave up his work at the Admiralty early in December in order to devote his whole time to the expedition. Minor work on the *Terra Nova* has already been begun, and a motor sledge of improved pattern is being constructed.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

Evaporation over Lakes and Reservoirs.—In the year 1907 there was carried out, in the neighbourhood of the Salton sea in Southern California and elsewhere in that region, an extensive research into the laws controlling the rate of evaporation in the open air over large lakes and reservoirs, with a view to arriving at some mathematical formula which should approximately represent the general law of evaporation. The U.S. Weather Bureau, the U.S. Reclamation Service, and the Water Resources Branches of the Geological Survey, co-operated to organize a simultaneous series of observations on the same plan at various places in the United States. Prof. Bigelow, who paid a visit of inspection to the observing stations, has set forth the results of the investigation in the Annual Summary of the *Monthly Weather Review* for 1908. Evaporation pans were used, together with such meteorological instruments like thermometers and psychrometers as the observations required, in three types of location, namely, a large water area, an irrigated field, and a dry area away from natural water or irrigated ground. As the result of

extensive computations upon the observations, it was decided to continue the researches with the aid of the following formula:—

$$E_0 = C_d \times 0{\cdot}100 \frac{e_s}{e_d} \cdot \frac{de}{ds}(1 + Aw)$$

where E_0 = the observed amount of evaporation per given time,

$\frac{e_s}{e_d}$ = expression for the vapour-pressure gradient,

$\frac{de}{ds}$ = rate of change of vapour-pressure in saturated condition, with temperature,

$(1 + Aw)$ = complication introduced by wind, w being the wind velocity,

and C_d = a coefficient containing thermodynamic constants, the evaporation interval of time, and some unknown function representing some physical process like diffusion which may influence the phenomenon of evaporation.

All these terms are determined by direct instrumental observation except the coefficient C_d, which can be secured, however, by a few days of observation at a given station. The coefficient C_d, which is, as intimated above, a variable, is simply the expression $\frac{E_0}{E_1 + E_1 Aw}$, E_0 being, as aforesaid, the amount of evaporation for a given interval, E_1 the computed or theoretical evaporation for the temperature conditions of the atmosphere per given time, and $E_1 Aw$ the wind effect; and its value is required to be established in many localities in order that a general evaporation formula, applicable under all conditions, may be arrived at. A knowledge of the C_d coefficient is extremely useful, as by it the amount of evaporation can be followed from the meteorological data more accurately than from the pan measurements, subject to all sorts of disturbing conditions.

Observations on Evaporation in the Atlantic Ocean.—Dr. Rudolf Lütgens, of Hamburg, has given in the *Annalen der Hydrographie und Maritimen Meteorologie* for 1909 (pp. 145–153) an account of scientific observations made during a voyage to the South Atlantic in 1908 (*Journal*, vol. 32, p. 536). The four-masted barque *Pangani* left Hamburg on September 12, and reached Valparaiso on December 15. The chief investigations carried out on board were those connected with evaporation and salinity, especially the former. The evaporation from the surface of the sea was obtained by the indirect method of determining the increase of salinity or salt-concentration of a quantity of sea-water placed in a vessel exposed to the air, the column of water evaporated being then easily obtained by calculation. Between lats. 40° N. and S., the mean 24-hourly amount of evaporation was 5·7 millimetres, but north and south of this zone only 3·2 millimetres. The maximum evaporation observed was in the Trade Wind regions in about 30° N. and 20° S., where it amounted to 7 or 8 millimetres. In the equatorial calm-belt the evaporation fell to about 4 millimetres, a fact easily accounted for by the high relative humidity of the air, the absence of wind, and the frequent cloudiness of the sky. The minimum daily evaporation of 2 millimetres was observed in the neighbourhood of Cape Horn, where the low temperature of air and water is clearly the cause of the small evaporation. After air and water temperature, a comparison of curves shows that wind is the most important factor influencing the rate of evaporation, but that the relative humidity of the air, as well as direct sunshine, also play, as one would expect, an important part. Both wind and sunshine, however, act by influencing the relative humidity of the air, the former by preventing saturation at a particular spot, the latter by raising the temperature of sea and the superincumbent air, which thus can take up more water-vapour. It is noteworthy in this connection that Dr. Mill's

evaporation experiments, conducted in a comparatively confined space at Camden Square, N.W., fail to show the relation between wind and evaporation. Since the amount of evaporation increases with the size of the evaporating vessel, it is important for comparative purposes to employ an evaporimeter of standard size. On board the *Pangani* the capacity was 2400 cubic centimetres, and an addition of 20 per cent. to the values obtained was considered by Dr. Lütgens to give an approximation to the actual evaporation over the surface of the ocean.

GENERAL.

Human Migrations.—Prof. G. F. Scott-Elliot, in a paper contributed to the *Transactions of the Dumfries and Galloway Natural History and Antiquarian Society*, gives a brief sketch of the course of human migrations, prehistoric and historic. Here reference is possible to only one or two of the indicated lines of migration. As in historic times the herdsmen of the Asiatic steppes, pressing northwards, forced other peoples towards Bering strait, so in prehistoric times must the Eskimo, driven into Asia's north-east corner, have been forced by them across the strait to the land looming in the distance. Next followed the ancestors of the American Indians, pressing the Eskimo into their present fastnesses. The main stream of new immigration, peopling the coast down to San Francisco, sent offshoots up the salmon rivers. Crossing the Rockies, these descended to live by hunting on the prairies. Growing more numerous, clans next pushed south by way of Mexico, Bogotá, and Peru, the old Inca highway crossing by Tucuman to Paraguay and the pampas. Hunting communities of superior vigour growing up in these pastures forced the Yaghan into the south-west of Tierra del Fuego. The jungle-forests of the Amazon, Gran Chaco, etc., are still the refuge of a miserable residuum. But how account for the flourishing states of ancient Mexico, Bogotá, and Peru, intersected by post-roads, irrigated from canals, glorified by temples? Had Asia any hand in such civilization? Attention is drawn to the similarity between the civilization of ancient China and that of ancient Peru, between the skull of the semi-civilized American and that of the Mongol (the Kurasiwo drift and Californian current might, it is suggested, bear Chinese and Japanese ships to American shores). Asia is taken as the starting-point of the South sea migrations. The Malay Mongol is tracked south-westwards. The Hovas of Madagascar, *e.g.*, are Malay immigrants of only three to four thousand years ago. Other migratory tracks include the line of the Siberian railway and that of the Cape-Cairo railway, with a western divergence at Khartum.

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1909-1910.

First Meeting, November 8, 1909.—Major Leonard Darwin, President, in the Chair.

Elections.—*Lieut. Willoughby Clive Garsia (Hampshire Regiment); Glynne G. Griffith-Williams; Captain Ronald Macclesfield Heath; Jesse Herbert; Lieut. John Meredith Holton (Sussex Regiment); William M. King; Maurice Macmillan; Major Oswald C. Williamson, R.A.*

The paper read was:—

"Journeys in Bhutan." By J. Claude White, c.i.e.

Second Meeting, November 15, 1909.—Major LEONARD DARWIN, President, in the Chair.

ELECTIONS.—*Reginald Akroyd; Rev. Joseph George Aldridge; Rev. Edward Arthur Aldridge; Fred. W. Ambrose; Lieut.-Colonel Arthur Fred. Appleton; Stephen Armitage, B.A.; Charles Robert J. Atkin-Swan, M.D.; Leon Aubert, B.A.; Frederick Robert Bader; Lindon Wallace Bates, C.E.; Walter Remington Bateson; Reginald Beddington; Hugh Massy Birch; J. Blum; Captain John Bois (King's Own Regiment); William Brettle; George Matthew Bridges; Rev. Augustus Briggs; Major Archie Stewart Buckle, R.A.; Thomas Carson; Douglas Carruthers; Edwin Herbert Cartwright; Julius Chambers; Captain J. R. Clarke (Norfolk Regiment); N. C. Cockburn; Robert E. Crane; J. P. Crommelin; Theophilus Clive Davies; Lieut. A. J. A. Douglas; St. Vincent Bowen Down; Lieut. W. D. Downes (Royal Sussex Regiment); James Alexander Duncan; Arthur Radcliffe Dugmore; Alexander Henderson Dunsmure; Frank Edgar; James Huston Edgar; Henry Gardiner Ferguson; George Vines Forrest; William Melville Foster; Hugh Moreton Frewen; Sydney Garne; Lieut. C. H. Gay, R.G.A.; Alfred Hamilton Grant, C.I.E.; J. H. Grieve; Arthur Groves; G. A. Hancock; Daniel Hanbury; Captain F. Hardy (Coldstream Guards); Captain F. de W. Harman (Norfolk Regiment); Robert Hawzhurst; George Evan Hesketh, M.A.; Edbert Ansgar Hewett; Paxton Hibben, M.A.; Captain C. C. H. Hogg, R.E.; William Hopkins; F. W. Leicester Hulk; Lieut. John Meredith Hulton (Sussex Regiment); Lyman Ward B. Jackman; Max S. Jacobson; Lieut. E. Gates-James, R.N.R.; Arthur Masson Kilby, M.A.; F. R. A. N. Knollys; Walter Russell Lambuth, M.A., D.D.; Jerome Landfield; Arthur Hyde Lay; T. H. Lawrence; George Gerard Longden; S. M. Lowenstein; Captain Edward Maitland Maitland (Essex Regiment); Major-General Sir Hugh McCalmont, K.C.B., C.V.O.; William James Thomas Mardon; Captain C. M. Marris; J. Graham de G. Martyr; Pe Maung; Major James Austin Meldon (Royal Dublin Fusiliers); Sid. Mitter (Rai Bahadur); Maung Mya-û; Francis Edward Norris; John Berwick Orgill; Rev. Harry Owen; Leonard Edgar Palmer; Lieut.-Colonel G. W. S. Patterson (Garrison Artillery); Laurence Richard Phillips; Somerset Playne; John Horton Pope, C.E.; John Richard Preece, C.M.G.; Colonel M. H. Purcell; Earl of Ranfurley, G.C.M.G.; Lieut.-Colonel Crompton Roberts; Fred Russell Roberts; Colonel William Howland Roberts, M.D.; Sir John Rodger, K.C.M.G. (Governor Gold Coast); Lionel Henry W. Sampson; Lieut. H. S. L. Scott (4th Hussars); San Shive; Fred. D. Snyder, M.D.; Barnard Sotham, C.E.; Graham Proctor Spicer; Gerhard A. Stockfeld; Mervyn Lawrence Tew; Peter Haig Thomas; Lieut. D. Hay Thorburn (Scottish Rifles); Rev. Edgar Vigers; Alfred R. Wagg; William Watkins; Harold Watson; Captain R. H. Watson (North Lancashire Regiment); Colonel George O. Welch, C.B.; Charles Stuart Welles; Richard Williams; Montagu Bouchier Wilson; Richard Winch; Robert Lloyd Woollcombe, M.A., LL.D.; Rev. Godfrey R. Wreford.*

The paper read was:—

"Mesopotamia: Past, Present, and Future." By Sir William Willcocks, K.C.M.G.

RESEARCH DEPARTMENT.

November 18, 1909.—Dr. A. STRAHAN in the Chair.

"Methods of Observation for Positions in the Polar Regions." By Arthur R. Hinks.

Third Meeting, November 22, 1909.—Major LEONARD DARWIN, President, in the Chair.

ELECTIONS.—*Frank Bodenham; Captain Arthur Dickson* (*1st S. Lancashire Regt.*); *Arthur Hudson; Joseph Boyd Love, J.P.; James Douglas Moffat; George Early Pitt; Edward Herbert Simpson* (*The King's Regt.*); *Henry John Swinburne.*

THE INTERNATIONAL MAP CONFERENCE.

The PRESIDENT said: We are honoured here to-night by the presence of nearly all the members of the Conference which has been sitting during the whole of last week at the Foreign Office, discussing the best arrangements for making a map of the world on the scale of 1:1,000,000. The idea of creating such a map was, I believe, first originated by Professor Penck, who now occupies the chair of Geography at the Berlin University. He originated the idea at the Berne Conference, and at that Conference a committee was appointed. At each succeeding Conference that committee sent in an ad-interim report. At the last Congress which was held, that of Geneva, it was decided that the time had arrived when more vigorous steps might be taken. Certain regulations were then drawn out for the creation of such a map, and the conclusions arrived at by the Congress were sent to all the principal governments of the world, in the hope that this might provoke some definite action. As a result, the British Government issued a certain number of invitations to attend a Congress in England, and I am glad to say that a large number of governments accepted the invitation. During the last week representatives of the United States, Austria-Hungary, France, Germany, Italy, Russia, Spain, and also of Canada and Australia, have been devoting their whole energies to this subject. The result is exceedingly satisfactory, for they have arrived at unanimous conclusions, and the document was signed this afternoon at the Foreign Office by every single one of the delegates. A report will be sent to all the governments of the world, and I cannot help thinking that this is the first step towards the actual creation of a map on a scale of 1:1,000,000 of the whole world on a uniform plan, and that this is the most important result which has ever been obtained from our International Congresses of Geography. I am quite sure that you will wish me, in the name of the Royal Geographical Society, to express our hearty congratulations to the Congress on the happy conclusions of these labours, and, if I may for once speak in the name of the science of geography, to thank these delegates for having come so far and for labouring so earnestly to produce such an excellent result.

The paper read was:—

"A Naturalist's Travels on the Congo–Zambezi Watershed." By S. A. Neave.

Fourth Meeting, December 6, 1909.—Major LEONARD DARWIN, President, in the Chair.

ELECTIONS.—*Hugh W. Coates; W. Hennessy Cook; Elphinstone Dayrell; Cyril H. James; Rudolph Said-Ruete; William Lutley Sclater, M.A.; David Simson; Joseph Mark Travers.*

The paper read was:—

"Explorations in the Hispar Region, Himalayas." By Dr. Hunter Workman and Mrs. Bullock Workman.

Fifth Meeting, December 13, 1909.—Major Leonard Darwin, President, in the Chair.

Elections.—*William Henry Brooks; Williamson Buckman; Charles P. Conigrave; John Gilbert Dale; Francis Deverell; Dr. Harold St. Clair Elliott; Major Douglas Evans Forman (Royal Field Artillery); A. S. Gladstone; Hon. Sir Duncan E. Hay, Bart; Aubrey Herbert; Alfred Hoare; The Right Hon. Henry Hobhouse; Hy. Richard Powell; J. G. Raggi; C. W. St. John Rowlandson; J. Obed Smith; Albert James Thompson; T. M. Williams.*

The paper read was:—

"Exploring Journeys in Turkey in Asia." By Captain Bertram Dickson.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., *Librarian*, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are as a rule written in full:—

A. = Academy, Academie, Akademie.
Abh. = Abhandlungen.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Col. = Colonies.
Com. = Commerce.
C.R. = Comptes Rendus.
E. = Erdkunde.
G. = Geography, Géographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Iz. = Izvestiya.
J. = Journal.
Jb. = Jahrbuch.
k.k. = kaiserlich und königlich.
M. = Mitteilungen.
Mag. = Magazine.
Mem. (Mém.) = Memoirs, Mémoires.
Met. (mét.) = Meteorological.
P. = Proceedings.
R. = Royal.
Rev. (Riv.) = Review, Revue, Rivista.
S. = Society, Société, Selskab.
Sc. = Science(s).
Sitzb. = Sitzungsbericht.
T. = Transactions.
Ts. = Tijdschrift, Tidskrift.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half inch. The size of the *Journal* is 10 × 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

Alps—Hydrology. *M. k.k. G. Ges. Wien* **52** (1909): 223-240. **Hoffer.**
Unterirdisch entwässerte Gebiete in den nördlichen Kalkalpen (II. Teil). Von Prof. Dr. Max Hoffer.

Austria—Bosnia and Servia. **Cvijić.**
L'annexion de la Bosnie et la question Serbe. Par Jovan Cvijić. Paris, 1909. Size 9 × 5½, pp. x. and 70. *Map. Presented by the Author.*

Austria—Istria. *M. k.k. G. Ges. Wien* **52** (1909): 241-262. **Perko.**
Die Tropfstein- und Wasserhöhle "Dimnice" (Rauchgrotte) bei Markovsina in Istrien (Österreich). Von G. And. Perko. *Sketch-map and Sections.*

Austria—Tyrol. *M. k.k. G. Ges. Wien* **52** (1909): 263-267. **Götzinger.**
Die Lunzer Seen. Von Dr. Gustav Götzinger.

Belgium—Geography. **Mees.**
Le Mouvement Scientifique en Belgique 1830-1905. Les Sciences Géographiques.

Par J. Mees. Bruxelles, 1907. Size 12 × 8½, pp. 48. *Portraits, Sketch-maps, and Illustrations. Presented by the Author.*

Denmark—Bornholm. **Braun.**

Ueber die Morphologie von Bornholm. Von Dr. Gustav Braun. (Sonderabdruck aus dem xi. Jahresbericht der Geographischen Gesellschaft zu Greifswald 1908–09). Greifswald, 1909. Size 9 × 6, pp. 163–200. *Maps, Illustrations, and Sections. Presented by the Author.*

Denmark—Geodesy. **Madsen and Sand.**

Den Danske Gradmaaling; Ny Række, Hefte Nr. 5. 6 Breddebestemmelser udførte i Aarene 1890–1892 efter Horrebows Metode, tilligemed Resultaterne af Gradmaalingens senere Breddebestemmelser. Udgivet af Generalmajor V. H. O. Madsen; endelig redigeret af Oberstløjt. M. J. Sand. Copenhagen, 1909. Size 11 × 9, pp. 120. *Map.*

Denmark—Geodesy. **Zacharias.**

Den Danske Gradmaaling; Ny Række, Hefte Nr. 4. Nivellement over bredere Vandarealer. Udgivet af den danske Gradmaaling efter afdøds General Zachariaes Manuskript. Copenhagen, 1909. Size 11 × 9, pp. 118. *Sketch-maps and Diagrams.*

Report of levelling across the Great and Little Belts, The Sound, etc.

Europe—Oil-fields. **Dalton.**

A Sketch of the Geology of the Baku and European Oil-fields. By Leonard V. Dalton. (Reprinted from *Economic Geology*, vol. 4, No. 2, March, 1909). London, 1909. Size 10 × 7, pp. 89–117. *Sketch-maps and Sections. Presented by the Author.*

Færoe Islands. *Deutsche G. Blätter* **32** (1909): 40–57. **Erkes.**

Reisebilder von den Färöern. Von Heinrich Erkes.

France—Cartography. **Fordham.**

The Cartography of the Province of France, 1570–1757. By Sir Herbert George Fordham. (From the Cambridge Antiquarian Society's *Communications*, vol. 13.) [Cambridge], 1909. Size 11½ × 9, pp. 82–119. *Sketch-map. Presented by the Author.*

Noticed in the October number, p. 452. The names of two of the cartographers referred to should read "Bouguereau," "Le Clerc," and not as in the notice.

France—Finistère—Sea-water. **Legendre.**

B.I. Océanog. Monaco, No. 144 (1909): pp. 30.

Recherches physico-chimiques sur l'eau de la côte, à Concarneau. Par R. Legendre. *Diagrams.*

France—Hautes Alpes. *La G., B.S.G. Paris* **19** (1909): 15–44, 97–110. **Blanchard.**

L'habitation en Queyras. Par Raoul Blanchard. *Illustrations.*

A study of the form and distribution (according to altitude, etc.) of the inhabited places.

France—Movement of Population. *B.S.G. Marseille* **32** (1908): 297–302. **Barré.**

La répartition des originaires des Bouches-du-Rhône dans les autres départements. Par Henri Barré.

France—Provence. *La G., B.S.G. Paris* **19** (1909): 441–443. **Lemoine.**

Les tremblements de terre de Provence. Par Paul Lemoine. *Sketch-map.*

France—Provence. *C.R.A. Sc. Paris* **148** (1909): 1696–1698. **Lemoine.**

Sur les relations tectoniques du tremblement de terre de Provence. Par Paul Lemoine. *Sketch-map.*

France—Rhone. *B.S.G. Lyon.* 2 Ser. **2** (1909): 1–16. **Frécon.**

La Navigation du Rhône et le projet de canal lateral. Par Pierre Frécon.

Germany—Baden. *Forschungen deuts. Landes- u. Volksk.* **18** (1909): 193–360. **Pfeiffer.**

Die Zusammensetzung der Bevölkerung des Grossherzogtums Baden nach der Geburtigkeit auf Grund der Volkszählung vom 1. Dezember 1900. Von Dr. Hans Pfeiffer. *Maps.*

Hungary—Lake Balaton. **Cholnoky.**

Das Eis des Balatonsees. Von Dr. Eugen von Cholnoky. (Separatabdruck aus dem Werke 'Resultate der wissenschaftlichen Erforschung des Balatonsees.' I.

Band, 5. Teil. iv. Section.) Budapest, 1909. Size 11½ × 8, pp. 114. *Illustrations and Diagrams. Presented by the Author.*

See review in the September number, p. 328.

Italy—Hydrology. **R. Magistrato alle Acque.**

R. Magistrato alle Acque: Ufficio Idrografico, Pubblicazione N. 1. Prima Relazione annuale del Direttone dell' Ufficio Idrografico. Venice, 1909. Size 10 × 7, pp. 32.

Referred to *ante*, p. 78.

Italy—Hydrology. **R. Magistrato alle Acque.**

R. Magistrato alle Acque: Ufficio Idrografico, Pubblicazione N. 2. Stazioni d'osservazione; opere idrauliche di 1ª e 2ª categoria. Magazzini idraulici. Venice, 1909. Size 10 × 7, pp. 176. *Sketch-maps.*

Lists of the rain, river, and tide observing stations, chiefly in Venetia, under the newly organized Hydrographical Office.

Italy—Liguria. *Ann. Museo Civ. Storia Nat. Genova* **3** (1907–08): 419–469. **Béguinot.**

La vegetazione delle isole liguri di Gallinaria, Bergeggi, Palmaria, Tino e Tinetto.—Studio floristico e biogeografico. Par Dr. Augusto Béguinot.

Italy—Relief. *B.S. Belge Géol.* **23** (1909): Proc.-Verb., 14–24. **Van de Wiele.**

L'évolution tectonique de la péninsule italienne depuis le Pliocène et ses rapports avec le sisme du détroit de Messine. Par C. van de Wiele.

Italy—Sicily. *Norske G.S. Aarbog* **19** (1907–08): 25–52. **Reusch.**

Sicilien: en geografiske skisse. Af Dr. Hans Reusch. *Sketch-maps and Illustrations.*

Italy—Sicily—Earthquake. *B. American G.S.* **41** (1909): 409–422. **Hobbs.**

The Messina Earthquake. By Prof. W. H. Hobbs. *Sketch-maps and Illustrations.*

Norway—Geology. **Oyen.**

Skrifter Videnskabs-S. Kristiania, Math.- Naturvid. Kl. 1908 (1909): No. 2, pp. 126.

Kvartær-studier i den sydøstlige del af vort land. Af P. A. Oyen.

Studies of Quarternary formations in South-Eastern Norway, and their fossils.

Norway—Southern. *Norske G.S. Aarbog* **19** (1907–8): 53–62. **Reusch.**

Geologiske og geografiske bemerkninger om det landskap man ser ut over fra Holmenkollen ved Kristiania. Af Dr. Hans Reusch. *Illustration and Sections.*

Rumania. ——

Ministère de l'Agriculture, de l'Industrie, du Commerce et des Domaines. La Roumanie, 1866–1906. Bucarest, 1907. Size 9½ × 6½, pp. viii. and 494. *Maps and Illustrations.*

Russia—Archangel. *Questions Diplomatiques* **28** (1909): 68–84. **Labbé.**

La province d'Arkhangelsk. Par Paul Labbé. *Sketch-map.*

Spain—Balearic Islands. *B.S.G. Com. Paris* **31** (1909): 521–541. **Gallois.**

L'archipel des Baléares. Par Eugène Gallois. *Sketch-map.*

Spain—Léon. *B.R.S.G. Madrid* **50** (1909): 41–80. **Ciria y Vinent.**

Excursiones en la provincia de Léon. El pais de los maragatos: las montañas del Teleno: las antiguas minas romanas. Conferencia leida el 9 de Diciembre de 1908. Por D. Joaquin de Ciria y Vinent. *Illustrations.*

Strait of Gibraltar. *C.R.A. Sc. Paris* **148** (1909): 1227–1230. **Gentil.**

Sur la formation du détroit de Gibraltar. Par Louis Gentil.

Sweden—Climatology. **Andersson.**

The Climate of Sweden in Late Quaternary Period. Facts and theories. By Gunnar Andersson. (Reprinted from *Sveriges Geologiska Undersökningo Årsbok*, 1909.) Stockholm, 1909. Size 9½ × 6½, pp. 88. *Sketch-maps, Illustrations, and Sections.*

See November number, p. 569.

Sweden—Seismology. **Svedmark.**

Sveriges Geol. Undersökning, Årsbok **2** (1908): No. 3, pp. 124 (Ser. C, No. 211).

Jordskalf i Sverige, 1904–1906. Af Eugene Svedmark. *Maps.*

United Kingdom. **Davies.**

A geography of the British Isles, with numerous practical exercises. By Dr. A. Morley Davies. London: Macmillan & Co., 1909. Size 7½ × 5, pp. xiv. and 358. *Sketch-maps, Illustrations, and Diagrams. Price 3s. Presented by the Publishers.*

See notice at p. 75, *ante*.

United Kingdom—Bedfordshire, etc. **Woodward and Thompson.**

Memoirs of the Geological Survey. England and Wales. The water-supply of Bedfordshire and Northamptonshire from underground sources, with records of sinkings and borings. By Horace B. Woodward and Beeby Thompson, with contributions on rainfall by Dr. Hugh Robert Mill. London: Wyman & Sons, 1909. Size 9½ × 6, pp. vi. and 230. *Sketch-maps. Price 4s. 6d.*

The rainfall section was referred to in vol. **34**, p. 451.

United Kingdom—Bibliography. **Sheppard.**

Bibliography: Papers and Records published with respect to the Geology and Palæontology of the North of England, 1902–1908. Compiled and edited by Thomas Sheppard. (Reprinted from the *Transactions of the Yorkshire Naturalists' Union*, part 34.) Hull: A. Brown & Sons, 1909. Size 9 × 6, pp. 120. *Presented by the Author.*

United Kingdom—Communications. *G. Teacher* **5** (1909): 96–105. **Fairgrieve.**

The Roads to the North. By J. Fairgrieve. *Sketch-map.*

Traces the influence of surface features in the history of communications between London and the north.

United Kingdom—Cornwall. *Globus* **94** (1908): 329–333, 347–350. **Spethmann.**

Grundzüge der Oberflächengestaltung Cornwalls. Von Hans Spethmann. *Diagram and Illustrations.*

United Kingdom—Cornwall. *Archæologia* **61** (1908): 1–60. **Gray.**

On the Stone Circles of East Cornwall. By H. St. George Gray. *Illustrations, Sections, and Plans.*

United Kingdom—Croydon. **Latham.**

A Chapter in the History of Croydon. By Baldwin Latham. London: West, Newman, & Co., 1909. Size 8½ × 5½, pp. 104. *Presented by the Author.*

Deals historically with the health of Croydon.

United Kingdom—Deneholes. *J.R. Anthropological I.* **39** (1909): 44–76. **Hayes.**

Deneholes and other Chalk Excavations: their Origin and Uses. By the Rev. J. W. Hayes. *Illustrations.*

See Monthly Record, *ante*, p. 76.

United Kingdom—Devon and Cornwall. **Spethmann.**

Die Küste der Englischen Riviera. Von Hans Spethmann. Meereskunde: Sammlung Volkstümlicher Vorträge zum Verständnis der Nationalen Bedeutung von Meer und Seewesen. (Band 3, Heft 5.) Berlin, 1909. Size 8½ × 6, pp. 36. *Sketch-map and Illustrations. Presented by the Author.*

Instructive studies in physical geography on the coasts of Devon and Cornwall.

United Kingdom—Geological Survey.

Memoirs of the Geological Survey. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for 1908. London, 1909. Size 9½ × 6, pp. 98. *Price 1s.*

United Kingdom—Hertfordshire. **Lydekker.**

Cambridge County Geographies (edited by F. H. H. Guillemard). Hertfordshire. By R. Lydekker. Cambridge: University Press, 1909. Size 7½ × 5, pp. x. and 174. *Maps, Illustrations, and Diagrams. Price 1s. 6d. Presented by the Publishers.*

United Kingdom—Ireland. **Westropp.**

The Forests of the Counties of the Lower Shannon Valley. By Thomas Johnson Westropp. (From the *Proceedings of the Royal Irish Academy*, vol. **27**, Section C, No. 13.) Dublin, 1909. Size 11 × 7½, pp. 270–300. *Sketch-maps.*

United Kingdom—Ireland—Archæology. **Kane.**

P.R. Irish A. **27** (1909): Sect. C, 301–328.

The Black Pig's dyke: the ancient boundary fortification of Uladh. By W. F. de Vismss Kane. *Sketch-map, Plan, and Sections.*

United Kingdom—Isle of Man. **Lamplugh.**

Memoirs of the Geological Survey: United Kingdom. The Geology of the Isle of Man. By G. W. Lamplugh. London, 1903. Size 10 × 6, pp. xiv. and 620. *Maps, Illustrations, and Sections. Presented by the Geological Survey.*

United Kingdom—Lancashire. **Weiss and Murray.**

Mem. and P. Manchester Lit. and Phil. S. **53** (1909): No. 14, pp. 8.

On the occurrence and distribution of some alien aquatic plants in the Reddish Canal. By Dr. F. E. Weiss and H. Murray.

United Kingdom—Map. *Globus* **96** (1909): 1-2. **Reinhard.**

Eine Manuskriptkarte der Britischen Inseln aus dem 16. Jahrhundert. Von Walter Reinhard. *Map.*

This was referred to in the October number (vol. **34**, p. 421).

United Kingdom—Mersey. **Nares.**

Report on the present state of the Navigation of the River Mersey (1908), to the Right Honourable the Commissioners for the Conservancy of the River Mersey. By Vice-Admiral Sir G. S. Nares. London: Darlington & Son, 1909. Size 9½ × 6, pp. 16. *Presented by the Acting Conservator.*

United Kingdom—Meteorology.

Godlee Observatory. Fourth Annual Report, 1908. Manchester, [1909]. Size 10 × 7, pp. 28. *Illustrations and Diagrams. Presented by the Principal.*

United Kingdom—Northumberland. **Knowles.**

J.R.I. Brit. Architects **16** (1909): 509-524.

Excavations at Corstopitum, Northumberland. By W. H. Knowles. *Plans, Sections, and Illustrations.*

This Roman settlement became important in the second century A.D.

United Kingdom—Rainfall. *G. Teacher* **5** (1909): 66-77. **Mill.**

Rainfall of the British Isles. By Dr. H. R. Mill.

United Kingdom—Scotland—Loch Earn. **Chrystal.**

T.R.S. Edinburgh **46** (1908-09): 455-518.

An Investigation of the Seiches of Loch Earn by the Scottish Lake Survey. Part III. Observations to determine the Periods and Nodes. Part IV. Effect of Meteorological Conditions upon the Denivellation of Lakes. Part V. Mathematical Appendix on the Effect of Pressure Disturbances upon the Seiches in a Symmetric Parabolic Lake. By Prof. Chrystal. *Diagrams.*

United Kingdom—Scotland—Lochs. **Eisenmenger.**

C.R.A. Sc. Paris **148** (1909): 1796-1797.

Sur l'origine glaciaire du Loch Lomond et du Loch Tay, en Écosse. Par Gabriel Eisenmenger.

United Kingdom—Severn. **Ellis.**

The Lower Severn Valley, River and Estuary from the Warwickshire Avon to the Bristol Avon. By T. S. Ellis. (From *Proc. Cotteswold Naturalists' F.C.*, vol. **16**, part 3, 1909.) Gloucester, 1909. Size 9½ × 6, pp. 241-263. *Sketch-maps and Diagrams. Presented by the Author.*

United Kingdom—Trent. **McAldowie.**

The Life History of the River Trent. By A. M. McAldowie. (Reprinted from *Transactions of the North Staffordshire Field Club*, vol. **43**, 1909.) N.P., 1909. Size 8½ × 5½, pp. 11. *Sketch-map and Section.*

United Kingdom—Windermere. **Weiss.**

Mem. and P. Manchester Lit. and Phil. S. **53** (1909): No. 11, pp. 10.

A preliminary account of the submerged vegetation of Lake Windermere as affecting the feeding-ground of fish. By Prof. F. E. Weiss.

Some of the bays are becoming choked with vegetation, including the rampant and troublesome Canadian pondweed.

ASIA.

Asiatic Languages.

A system for the transliteration of Persian, Afghan, and Arabian words. Compiled under the direction of the Foreign Department in India and of the Division of the Chief of the Staff, Intelligence Branch. Calcutta, 1909. Size 9½ × 6, pp. 72. *Presented by the Chief of the Staff, Indian Army.*

Central Asia—Tian-shan. *M. k.k. G. Ges. Wien* **52** (1909): 10–75. **Prinz.**

Die Vergletscherung des nördlichen Teiles des zentralen Tian-schan-Gebirges. Von Dr. Gyula Prinz. *Sketch-maps, Sections, and Illustrations.*

Ceylon—Survey. **Templeton.**

Survey Department, Ceylon. Report of Mr. R. S. Templeton, acting Surveyor-General. (Administration Reports, (1908, part i.) Size 13 × 8½, pp. 16. *Plan, Maps, and Illustrations. Presented by the Surveyor-General.*

China—Archæology. **Carus and Holm.**

The Nestorian Monument. An ancient record of Christianity in China. With special reference to the expedition of Frits V. Holm. Edited by Dr. Paul Carus. Chicago, 1909. Size 9 × 6, pp. 42. *Illustrations. Presented by Mr. Frits V. Holm.*

Mr. Holm recently carried out the difficult task of obtaining a replica of this monument.

Chinese Empire—Manchuria. *J. Tokyo G.S.* **21** (1909): 309–319. **Torii.**

A travel to the Sira-muren and the Khingan mountains, China. By R. Torii. *Sketch-map.* [In Japanese.]

Chinese Turkestan. *B.S.R. Belge G.* **33** (1909): 97–108. **Bourgeois.**

Notes sur l'Orographie, les Villes, la Population, et l'Administration du Turkestan Oriental. Par H. Bourgeois.

French Indo-China—Cambodia. *B.S.G. Comm. Paris* **31** (1909): 542–554. **Truffot.**

Note sur les irrigations et la mise en valeur de la vallée du Mékong au Cambodge. Par Truffot.

India—Himalaya. **Cora.**

Guido Cora. La spedizione del Duca degli Abruzzi ai Monti Karakorum. (Dalla "Nuova Antologia," 1° Aprile 1909.) Rome, 1909. Size 9½ × 6½, pp. 8.

India—Kashmir. *Records Geol. Surv. India* **37** (1909): 286–327. **Middlemiss.**

Gondwanas and Related Marine Sedimentary Systems of Kashmir. By C. S. Middlemiss. *Diagrams.*

India—Survey. ———

General Report on the Operations of the Survey of India . . . during 1907–08. Prepared under the direction of Colonel F. B. Longe. Calcutta, 1909. Size 14 × 8½, pp. iv. and 62. *Maps and Illustration.*

Indian Ocean—Seychelles. **Fauvel.**

Unpublished documents on the history of the Seychelles Islands anterior to 1810, together with a cartography . . . and a bibliography of books and MSS. concerning these islands. Compiled by A. A. Fauvel, and published by order of the Governor of Seychelles (pp. xxxii., 418, and 6). List of maps and plans (pp. 28). Mahé (Seychelles), 1909. Size 9½ × 6½. *Maps in separate Portfolio* (size 26 × 17). *Presented on behalf of the Government of Seychelles by the Colonial Office.*

Japan—Bonin Islands. **Hattori.**

J. College Sc. Imp. Univ. Tokyo **23** (Art. 10) (1908): pp. 64.

Pflanzengeographische Studien über die Bonin-Inseln. Von H. Hattori. *Map and Illustrations.*

Japan—Formosa—Cartography. **Teleki.**

Connaissance et Représentation Cartographique de Formose jusqu'à la fin du XVII[ème] Siècle. Par M. le comte Paul Teleki. (Revue de Hongrie, tome III. No. 5, 1909.) Budapest, 1909. Size 9½ × 6½, pp. 566–581.

A chapter from the author's large work on the Cartography of Japan.

Japan—Formosa—Mount Morrison. **Arnold.**

J. North China Br. R. Asiatic S. **40** (1909): 44–68.

The ascent of Mount Morrison (Niitaka Yama). By Julean H. Arnold. *Maps and Illustrations.*

The ascent was made in 1907 (see note in Monthly Record, December, p. 679).

Japan—Kyūshū—Mount Aso. *J. Tokyo G.S.* **21** (1909): 353–356. **Iwasaki.**

Recent State of the Eruption of Aso Volcano. By J. Iwasaki. *Diagrams* [In Japanese.]

Japan—Kyūshū—Mount Aso. **Nakamura and Hiratsuka.**

J. Tokyo G.S. **21** (1909): 180–186.

Some altitude Measurements in Aso Volcano. By Seiji Nakamura and Chunosuke Hiratsuka. [In Japanese.]

Japan—Nippara Caves. *J. Tokyo G.S.* **21** (1909) : 429–434. **Wakimizu.**
Limestone Caves of Nippara in Musashi. By T. Wakimizu. [In Japanese.]

Japan—Subsidence. *J. Tokyo G.S.* **21** (1909): 356-360. **Sasamoto.**
Depression of the land along the line of Railway Hyūga. By J. Sasamoto. *Illustration.* [In Japanese.]

Philippine Islands. *Philippine J. Sc.* **4** (1909): 1–18. **Ferguson.**
Physiography of the Philippine islands. III. Western Masbate. By Henry G. Ferguson. *Maps.*

Philippine Islands. *Philippine J. Sc.* **4** (1909): 19–26. **Smith.**
Contributions to the physiography of the Philippine Islands. IV. The Country between Subig and Mount Pinatubo. By Warren D. Smith. *Sketch-map and Illustrations.*

Philippines—Sulu Archipelago. **Saleeby.**
Philippine Bur. Sc., Div. Ethnol. Pub. **4** (1908): 117–391.
The History of Sulu. By Najeeb M. Saleeby. *Sketch-maps and Diagrams.*
Opens with a geographical description of the archipelago.

Russia—Altai. *Annuaire géol. et min. Russie* **12** (1910): 1–7. **Pilipenko.**
Zur Frage über die Glacial-Periode im Altai. Von P. P. Pilipenko. *Illustrations and Section.* [In Russian; *résumé* in German.]

Russia—Aral. *Petermanns M.* **55** (1909): 82–86. **Woeikof.**
Der Aralsee und sein Gebiet nach den neuesten Forschungen. Von Prof. Dr. A. Woeikow. *Maps.*

Russia—Siberia—Khatanga. **Tolmatschof.**
Travaux Sous-Sect. Troïtzkossawski-Kiakhta, Imp.-Russ. G.S. **9** (1906): No. 1, 6–27.
Expédition de Khatanga de la Société Russe de geographie. Par I. P. Tolmatschow. [In Russian.]

Turkey—Adana.
Turkey. Report for the year 1908 on the trade of the province of Adana. (Diplomatic and Consular Reports, Annual series, No. 4235, 1909.) Size 9½ × 6, pp. 26. *Price* 2d.

Turkey—Kurdistan. *J.R. Anthropological I.* **38** (1908): 451–486. **Sykes.**
The Kurdish Tribes of the Ottoman Empire. By Mark Sykes. *Sketch-map.*

Turkey—Railway. *Globus* **95** (1909): 201–206. **Janke.**
Die Bagdadbahn und der Gülek Boghas (Cilicische Tore) im Taurus. Von A. Janke. *Illustrations.*

AFRICA.

Belgian Congo—Zoology. **Schouteden.**
Annales du Musée du Congo. Zoologie—Serie III. Catalogues raisonnés de la Faune Entomologique du Congo Belge. Hémiptères, fam. Pentatomidæ, par H. Schouteden. Tome I. Fascicule I. Brussels, 1909. Size 14½ × 11, pp. 1–86. *Illustrations.*

French Congo. *B.S.G. Marseille* **32** (1909): 303–343. **Baudon.**
De Brazzaville à Franceville: Les savanes du Congo français. Par M. A. Baudon.

French Congo. *B.S.G. Marseille* **32** (1909): 344–355. **Roche.**
Au pays des Pahouins: Du Gabon au Cameroun. Conférence de M. le commandant Roche.

French Sudan. *C.R.A. Sc. Paris* **148** (1909): 1698–1700. **Garde.**
Aperçu géologique sur les régions situées à l'est et au nord-est du Tchad. Par G. Garde. *Sketch-map.*

French West Africa—Senegal. *B.S.G. Comm. Bordeaux* **32** (1909): 49–55. **Fromaget.**
L'hydrographie du fleuve Sénégal. Par Capitaine Fromaget.

German South-West Africa. *Z. Kolonialpolitik* **10** (1908): 857–864. **Fitzner.**
Die Regenverhältnisse Deutsch-Südwestafrikas. Von Prof. Dr. Rud. Fitzner.

German South-West Africa—Diamonds. **Merensky.**
T. Geol. S. South Africa **12** (1909): 13–23.
The diamond deposits of Luderitzland, German South-West Africa. By Hans Merensky. *Sketch-map and Illustrations.*

German South-West Africa—Ethnology. **Geibel.**
Deutsches Kolonialblatt **20** (1909): 824–833.
Die Eingeborenen der deutschen Kalahari. Von Leutnant Geibel.

German South-West Africa. [**Dinter.**]
Deutsches Kolonialblatt **20** (1909): 783–787.
Eine botanische Forschungsreise nach dem Norden.

Gold Coast. ———
Northern territories of the Gold Coast. Report for 1908. (Colonial Reports, Annual, No. 602, 1909.) Size 9½ × 6, pp. 18. *Price* 1½*d.*

Gold Coast—Disease. **Simpson.**
Report on plague in the Gold Coast in 1908. By Dr. W. J. Simpson. London: J. & A. Churchill, 1909. Size 13 × 8½, pp. 56. *Illustrations and Diagrams. Price* 2*s. net. Presented by the Publishers.*

Kamerun. *Deutsches Kolonialblatt* **20** (1909): 860–866. **Schorkopf.**
Die forstwissenschaftliche Expedition, 1908-09. (Bericht des Forstassessors Schorkopf.)
See note in vol. **34**, p. 682.

Kamerun. *Globus* **95** (1909): 133–138. **Diesing.**
Von Joko nach Ngaumdere. Eine Reise in Adamaua. Von Dr. Ernst Diesing.

Kamerun. *Deutsches Kolonialblatt* **19** (1908): 1148–1151. ———
Die Alkasom—Muntschi—Bascho-Expedition. *Sketch-map.*
The field of operations was north-east of the Cross river, near the Nigerian frontier.

Madagascar—Ethnology. *J. Asiatique* **11** (1908): 353–500. **Ferrand.**
L'origine africaine des Malgaches. Par Gabriel Ferrand.

Madagascar—Tritriva volcano. **Bourdariat and Johnston-Lavis.**
B.S. Belge Géol., Mém. **22** (1908): 103–116.
Note sur le remarquable volcan de Tritriva au centre de l'île de Madagascar avec des observations sur l'origine du quartz dans les basaltes et autres roches basiques. Par Alexandre Bourdariat et Dr. Johnston-Lavis. *Sketch-map, Diagrams, and Illustrations.*

Nigeria—Ethnology. **Parkinson.**
Yoruba Folk-Lore. By John Parkinson. (Reprinted from the *Journal of the African Society*, vol. **8**, 1909.) London, 1909. Size 8½ × 6, pp. 165–186. *Presented by the Author.*

Nigeria—Northern. **Dunstan.**
Northern Nigeria. Report on the results of the Mineral Survey, 1906–07. By Prof. Wyndham R. Dunstan. (Colonial Reports, Miscellaneous, No. 59, 1909.) Size 9½ × 6, pp. 22. *Price* 1½*d.*

Nile—Historical. **Partsch.**
Des Aristotle's Buch 'Ueber das Steigen des Nil.' Eine Studie zur Geschichte der Erdkunde im Altertum. Von J. Partsch. (Des xvii. Bandes der Abhandlungen der Philosophisch-Historischen Klasse der Königl. Sächsischen Gesellschaft der Wissenschaften No. 16.) Leipzig: B. G. Teubner, 1909. Size 11 × 7½, pp. 551–600. *Diagram.*

Nile Basin—Meteorology. **Lyons.**
Egypt. Survey Department Paper, No. 9. The Rains of the Nile Basin and the Nile Flood of 1907. By Captain H. G. Lyons. Cairo, 1909. Size 10½ × 7½, pp. 60. *Sketch-map and Diagrams.*

Nyasaland. *J.R. Anthropological I.* **39** (1909): 35–43. **Stigand.**
Notes on the Tribes in the neighbourhood of Fort Manning, Nyassaland. By Captain C. H. Stigand.

Rhodesia. *Quart. J. Geol. S.* **65** (1909): 408–439. **Molyneux.**
On the Karroo System in Northern Rhodesia, and its Relation to the General Geology. By Arthur John Charles Molyneux. *Sketch-maps, Sections, and Illustrations.*

Rhodesia—Rainfall. *G. Teacher* **5** (1909): 77–81. **Tripp.**
Rainfall of Southern Rhodesia. By C. E. Tripp and F. E. B. Tripp.

Sahara—Geology. *C.R.A. Sc. Paris* **148** (1909): 1616–1619. **Garde.**

Résultats de l'exploration géologique et minéralogique de l'Eguéï. Par G. Garde.

Sahara—Observations. *La G., B.S.G. Paris* **19** (1909): 111–115. **Niéger.**

Observations astronomiques dans le Sahara algérien. Tidikelt et partie sud du territoire d'Aïn-Sefra (mars et avril 1907). Par J. Nieger.

Sahara—Sands. *B.S.G. Alger* **13** (1908): 141–180. **Cauvet.**

Les Sables du Sahara Algérien. Par Commdt. Cauvet. *Illustrations.*

South Africa—Geology. **Schwarz.**

The discoveries of economic importance made by the Albany pioneers. By E. H. L. Schwarz. (Presidential Address, Sections B and C; South African Association, Grahamstown, 1908.) Grahamstown, 1908. Size 9 × 6, pp. 16. *Portrait.*

Uganda.

Uganda-Report for 1907–08. (Colonial Reports, Annual, No. 600, 1909.) Size 9½ × 6, pp. 36. *Sketch-map. Price* 4½*d.*

Victoria Nyanza. **Craig.**

Earth-movements at Lake Victoria. By J. I. Craig. (Reprinted from the *Cairo Scientific Journal*, No. 31, vol. 3, April, 1909.) Alexandria, 1909. Size 10½ × 7 (1 page).

The writer contests Captain Lyons' conclusions (cf. *Journal*, vol. 33, p. 328), but the latter has since (same *Journal*, July, p. 176) shown that his meaning had been in part misunderstood by Mr. Craig.

West Africa—Boundary.

Treaty Series, No. 17, 1909. Exchange of notes between the United Kingdom and Germany, confirming protocols defining Boundaries between British and German Territories in Africa. I. Gorege to Lake Chad (February 12, 1907). II. Uba to the Maio Tiel (March 11, 1907). London, 1909. Size 9½ × 6, pp. 6. *Map. Price* 6½*d.*

The protocols, originally signed by the British and German local representatives in 1907, refer to special sections of the boundary regarding which questions had arisen.

NORTH AMERICA.

Alaska. **Greely.**

Handbook of Alaska: its resources, products, and attractions. By Major-General A. W. Greely. London: T. Fisher Unwin, 1909. Size 8½ × 5½, pp. xiv. and 280. *Maps and Illustrations. Price* 8*s.* 6*d. net.*

Alaska. *National G. Mag.* **20** (1909): 585–593. **Greely.**

The Economic Evolution of Alaska. By Major-General A. W. Greely. *Illustrations.*

Alaska. *Appalachia* **12** (1909): 45–54. **Solomons.**

Surface Features of Northern Alaska. By Theodore S. Solomons.

Alaska—Mountains. *National G. Mag.* **20** (1909): 611–623. **Sargent.**

The Monarchs of Alaska. By R. H. Sargent. *Illustrations.*

Alaska and Canada—Boundary. *National G. Mag.* **20** (1909): 593–607. **Riggs.**

Marking the Alaskan Boundary. By Thomas Riggs. *Illustrations.*

Canada.

Annual Report of the Department of the Interior for the Fiscal year ending March 31, 1908. Ottawa, 1909. Size 9½ × 6½, pp. xl. and 414. *Illustrations.*

Includes, as usual, the report of the Surveyor-General, also issued separately in an enlarged form.

Canada.

Supplement to the Annual Report of the Department of Marine and Fisheries. Marine. Seventh Report of the Geographic Board of Canada, containing all decisions to June 30, 1908. Ottawa, 1909. Size 9½ × 6½, pp. 100.

Canada—Rocky Mountains. *Canadian Alpine J.* **2** (1909): 79–84. **Burwash.**

Structures in the vicinity of Rogers Pass. By E. M. Burwash. *Sketch-map and Sections.*

Canada—Selkirks. *Appalachia* **12** (1909): 16–30. **Palmer.**

A Pioneer Reconnaissance in the Northern Selkirks. By Howard Palmer. *Sketch-map and Illustrations.*

Canada—Surveys.

Department of the Interior. Annual Report of the Topographical Surveys Branch, 1907–08. Ottawa, 1909. Size 9½ × 6½, pp. vi., and 362. *Sketch-map and Illustrations. Maps in Separate Cover.*

United States—Magnetism. **Hazard.**

Department of Commerce and Labor. Coast and Geodetic Survey. Results of Observations made at the Coast and Geodetic Survey Magnetic Observatory at Baldwin, Kansas, 1901–1904. By Daniel L. Hazard. Washington, 1909. Size 11 × 9, pp. 138. *Illustrations.*

The Same, at Cheltenham, Maryland, 1901–1904. Washington, 1909. Pp. 206. *Sketch-map, Diagrams, and Illustrations.*

United States—Maine. **Clapp and Bayley.**

U.S. Geol. Surv., Water-Supply Paper **223** (1909): pp. 268.

Underground waters of Southern Maine. By Frederick G. Clapp, with records of deep wells by W. S. Bayley. *Sketch-maps, Diagrams, and Illustrations.*

United States—Maine. *U.S. Geol. Surv. B.* **376** (1909): pp. 128. **Bastin and Davis.**

Peat Deposits of Maine. By Edson S. Bastin and Charles A. Davis. *Sketch-maps and Illustrations.*

United States—Montana. *U.S. Geol. Surv. B.* **356** (1909): pp. 86. **Fisher.**

Geology of the Great Falls Coalfield, Montana. By Cassius A. Fisher. *Sketch-maps, Sections, and Illustrations.*

United States—Montana. **Fisher.**

U.S. Geol. Surv. Water-Supply Paper **221** (1909): pp. 90.

Geology and Water Resources of the Great Falls Region, Montana. By Cassius A. Fisher. *Maps and Illustrations.*

United States—Population. *J.R. Anthropological I.* **38** (1908): 221–240. **Ripley.**

The European population of the United States. By Prof. William Z. Ripley.

United States—Wyoming. **Darton and Siebenthal.**

U.S. Geol. Surv. B. **364** (1909): pp. 82.

Geology and Mineral Resources of the Laramie Basin, Wyoming. A preliminary report by N. H. Darton and C. E. Siebenthal. *Maps, Sections, and Illustrations.*

CENTRAL AND SOUTHERN AMERICA.

Argentine—Andes. *Sitzb. A.W. Wien* **116** (Abt. I.) (1907): 649–674. **Keidel.**

Ueber den Bau der argentinischen Anden. Von H. Keidel. *Sections.*

Argentine—Archæology. **Debenedetti.**

Excursión arqueológica á las ruinas de Kipón (Valle Calchaquí—Provincia de Salta). Por Salv. Debenedetti. Buenos Aires, 1908. Size 11 × 7½, pp. 56. *Plan and Illustrations. Presented by the Author.*

Bolivia. **Ballivián.**

Delegación Nacional del Territorio de Colonias del N.O., Bolivia, 1908. Informe del Delegado Nacional, Adolfo Ballivián (pp. vi, 238, and vi.). Anexos al Informe (pp. vi. and 138). [Para, 1909.] Size 9½ × 6½. *Maps. Presented by the Author.*

Brazil. **Lima.**

Le Brésil. Ses Limites actuelles; ses voies de pénétration. Rapports présentés au Congrès International de Géographie de Genève, Juillet-Août 1908. Par M. de Oliveira Lima. Antwerp, 1908. Size 8½ × 5½, pp. 14. *Maps. Presented by the Author.*

Brazil. *Deutsches Kolonialblatt* **20** (1909): 498–511, 541–557. **Sandmann.**

Eine Studienreise in das tropische Brasilien. Von D. Sandmann. *Illustrations.*

Chile.

Chile: a handbook. Compiled by the International Bureau of American Republics. Washington, D.C.: Bureau, [1909]. Size 9½ × 6, pp. 236. *Map and Illustrations. Presented by the Bureau.*

Chile—Treaties. **Pinilla.**

Ministerio de Relaciones Exteriores. Anexos á la Memoria presentada por el Ministro Dr. Claudio Pinilla (Tratados Vigentes), 1908. Santiago de Chile, 1908. Size 10½ × 7, pp. 876.

AUSTRALASIA AND PACIFIC ISLANDS.

New Caledonia—Climatology. **Mialaret and Fraysse.**

Contribution à l'étude du Climat de la Nouvelle-Calédonie. (La Pluie de 1903 à 1908.) Par Dr. H. Mialaret et A. Fraysse. Noumea, 1909. Size, 9½ × 6, pp. 16.

See note in the Monthly Record, *ante*, p. 82.

South Australia. **Bonnin.**

P.R.G.S. Australasia, South Austr. Br. **10** (1907-08): 67-89.

North-western District of South Australia, in September, 1862. By Josiah Bonnin.

South Australia—Geology. **Howchin.**

P.R.G.S. Australasia, South Austr. Br. **10** (1907-08): 204-219.

Geological Observations on some of the Localities visited by the "Governor Musgrave" Party in January, 1907. By Walter Howchin. *Illustrations.*

POLAR REGIONS.

Antarctic – German Expedition. **Drygalski.**

Deutsche Südpolar Expedition 1901-1903. . . . herausgegeben von Erich v. Drygalski. II. Band, Heft 1 (pp. 1-124); IV. Band, Heft 1 (pp. 1-124); and V. Band, Heft 2 (pp. 105-310). Berlin: G. Reimer, 1909. Size 14 × 10½. *Maps and Illustrations. Presented by the Imperial Foreign Office, Berlin.*

Antarctic—German Expedition. **Drygalski.**

Deutsche Südpolar-Expedition, 1901-1903. . . . herausgegeben von Erich von Drygalski. Vols. **9** and **10** (Zoologie, Bände I. und II.). Berlin: G. Reimer, 1908-1909. Size 13½ × 10, pp. (vol. **9**) xii. and 568; (vol. **10**) viii. and 604. *Maps and Illustrations. Presented by the Imperial Foreign Office, Berlin.*

Arctic—Meteorology. *Symons's Met. Mag.* **44** (1909): 139-141. ———

The Lowest Temperature on the Earth's Surface.

Refers to Dr. Cook's report of a temperature of −83° F.

Arctic—Spitsbergen. *Norske G.S. Aarbog* **19** (1907-8): 134-154. **Isachsen.**

Spitsbergenekspeditionen 1907. Af Gunnar Isachsen. *Sketch-map.*

Greenland—Amdrup Expedition. **Amdrup and others.**

Meddelelser om Grønland **28** (1904-09): pp. 542.

Carlsbergfondets Expedition til Ost-Gronland, udført i Aarene 1898-1900 under Ledelse af G. Amdrup. *Maps, Diagrams, Illustrations.*

Greenland—Eskimo. **Thalbitzer**

Ethnological description of the Amdrup collection from East Greenland, comprising objects found in Eskimo house-ruins and graves north of Angmagsalik between 68° and 75° lat. N. By W. Thalbitzer. (Reprinted from *Meddelelser om Grønland*, vol. **28**.) Copenhagen, 1909. Size 9 × 6, pp. 328-550. *Illustrations.*

Cf. note in the October number, p. 459.

Greenland—Oceanography. *La G., B.S.G. Paris* **19** (1909): 417-434. **Damas.**

L'océanographie de la mer du Grönland. Résumé des observations de l'expédition de la Belgica en 1905. Par D. Damas. *Charts and Illustrations.*

MATHEMATICAL GEOGRAPHY.

Cartography. *M. k.k. G. Ges. Wien* **52** (1909): 186-194. **Brückner.**

Zur Frage der Farbenplastik in der Kartographie. Von Eduard Brückner und Dr. Arthur Brückner. *Illustrations.*

Cf. note in vol. **29**, p. 680.

Mathematical Geography. *M. k.k. G. Ges. Wien* **52** (1909): 150-185. **Möller.**

Graphische Lösung von Aufgaben aus der astronomische Erdkunde. Von Dr. Max Möller. *Illustrations.*

Navigation—Great Circles. *Ann. Hydrographie* **36** (1909): 497-501. **Kobbe.**

Angenäherte Darstellung des Hauptbogens in der Merkatorkarte. Von Oberstleut. v. Kobbe. *Diagrams.*

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Cartography—Projection. *Scottish G. Mag.* **25** (1909): 449–469. **Cahill.**
An Account of a New Land Map of the World. By Bernard J. S. Cahill. *Sketch-maps and Diagrams.*

Describes a somewhat complicated system of projection, by which distortion of the land-mass can be reduced to a minimum.

Climatology. *Monthly Weather Rev.* **36** (1908): 359–364; 446–450. **Huntington.**
The climate of the historic past. By Ellsworth Huntington. *Diagram.*

Geomorphology—Mountain Ranges. **Sawicki.**
M. k.k. G. Ges. Wien **52** (1909): 136–149.
Der Nordappenin und die Westkarpathen, eine morphologische Parallele. Von Dr. Ludomir R. v. Sawicki. *Sections.*

Geophysics. *Geol. Mag.* v. **6** (1909): 145–148. **Schwarz.**
Secular Earth-Creep. By Prof. E. H. S. Schwarz. *Sketch-map.*

The writer suggests that the sun's attraction "must in course of geological periods cause the ridges in the Earth's crust to creep westwards," a continuous obliteration of features being the result.

Glacial Periods. *B.S. Belge Géol.* **23** (1909): 154–160. **Grégoire.**
Sur une cause possible de la glaciation du globe terrestre. Par Ach. Grégoire.

The suggested cause is the reversal of the normal difference of temperature between continental and suboceanic areas, caused by oscillations between sea and land.

Glacial Periods. *Deutsche G. Blätter* **32** (1909): 1–30. **Nölke.**
Die Entstehung der Eiszeiten. Von Dr. Fr. Nölke.

Glaciers. *Canadian Alpine J.* **2** (1909): 92–96. **Reid.**
Observations of Glaciers. By Harry Fielding Reid. *Illustrations.*

Hints on observing glaciers.

Glaciers. *Canadian Alpine J.* **2** (1909): 56–78. **Vaux.**
Modern Glaciers. By Wm. S. Vaux. *Illustrations.*

Meteorology—Evaporation. *Monthly Weather Rev.* **36** (1908): 437–445. **Bigelow.**
Studies on the phenomena of the evaporation of water over lakes and reservoirs. IV. The progress of the research in 1908, and the proposed campaign for the years 1909 and 1910. By Prof. Frank H. Bigelow.

See *ante*, p. 83.

Meteorology—Refraction. *Cairo Sc. J.* **3** (1909): 129–136. **Xydis and others.**
Terrestrial Refraction at Alexandria. By C. Xydis, with a note by J. I. Craig.
Refraction across the Nile Valley. By E. F. E. Keeling. *Diagram.*

See *ante*, p. 79.

Rocks. **Fletcher.**
British Museum (Natural History). Mineral Department. An Introduction to the Study of Rocks, and Guide to the Museum Collection. By L. Fletcher. Fourth edition. London, 1909. Size 8½ × 5½, pp. viii. and 156. *Plan. Presented.*

Seismology. *J. Franklin I.* **167** (1909): 434–472. **Carter.**
Earthquakes in the Light of the New Seismology. By Prof. Oscar C. S. Carter. *Sketch-map, Illustration, and Diagrams.*

Seismology. *Quart. Review* **419** (1909): 477–500. **Davison.**
Earthquakes and their Causes. By Charles Davison. *Diagram.*

Seismology. *J. African S.* **8** (1909): 398–411. **Struck.**
African ideas on the subject of Earthquakes. By Bernhard Struck.

See vol. **34**, p. 457.

Subterranean Fire. *Sitzb. math.-phys. Kl. A.W. München*, 1908: 123–139. **Günther.**
Erdbrände und deren angebliche geophysische Konsequenzen. Von Siegmund Günther.

An examination of Werner's Theory of Vulcanicity, with a discussion of the pseudo-volcanic phenomena of burning mountains, etc.

Tides. **Harris.**
The Tides, their causes and representation. By Rollin Arthur Harris. (Reprinted

from the *Popular Science Monthly*, June, 1909.) New York, 1909. Size 10 × 7, pp. 521–539. *Charts and Diagrams.*

Tides. *Beiträge Geophysik* **10** (1909): 125–151. **Müller.**

Zur Theorie der Entstehung der Tiden. Von Aloys Müller. *Diagrams.*

GENERAL.

Bibliography. **Baschin.**

Bibliotheca Geographica. Herausgegeben von der Gesellschaft für Erdkunde zu Berlin. Bearbeitet von Otto Baschin. Band xiv. 1905. Berlin: W. H. Kühl, 1909. Size 9½ × 6, pp. xvi. and 545. *Presented by the Gesellschaft für Erdkunde, Berlin.*

British Empire—Surveys.

The surveys of British Africa, Ceylon, the Federated Malay States, Jamaica, Trinidad, British Honduras, Fiji. The annual report of the Colonial Survey Committee. Fourth year: to March 31, 1909. (Colonial Reports, Annual No. 608, 1909.) Size 9½ × 6, pp. 52. *Index-map and Illustration. Price* 1*s.* 7*d.*

This was noticed in the December number, p. 618.

Education. *J.G.* **7** (1909): 193–208. **Marbut.**

The College Unit in Physical Geography. By C. F. Marbut.

On the scope and methods of geography in Education. (See October number, p. 460.)

Education—Map-reading. *G. Teacher* **5** (1909): 81–85. **Reynolds.**

Map Reading and Imagination. By Joan B. Reynolds.

Education—Models. *G. Teacher* **5** (1909): 19–23. **McMichael.**

A method of modelling in relief by means of serial sections from a contoured map. By J. A. McMichael. *Illustrations.*

Education—Surveying. *G. Teacher* **5** (1909): 86–90. **Deas and Mort.**

Surveying in Schools. By J. Deas and F. Mort. *Sketch-map.*

Education—Text-book. **Wallis.**

Practical exercises in geography: A two years' course. By B. C. Wallis. London: Macmillan & Co., 1909. Size 7½ × 5, pp. xxiv. and 184. *Sketch-maps, Illustrations, and Diagrams. Price* 2*s.* 6*d. Presented by the Publishers.*

Mountaineering. *Appalachia* **12** (1909): 30–33. **Balch.**

High Mountain Ascents. By Edwin Swift Balch.

Notes on the highest ascents of recent years.

Ski in Mountaineering. *Alpine J.* **24** (1909): 553–564. **Clarke.**

Mountaineering on Ski. By E. Russell Clarke. *Illustrations.*

NEW MAPS.

By E. A. REEVES, *Map Curator*, R.G.S.

EUROPE.

British Isles—England and Wales. **Ordnance Survey.**

Sheets published by the Director-General of the Ordnance Survey, Southampton, from November 1 to 30, 1909.

4 miles to 1 inch:—

Revised, in outline, engraved, 8 (20 and 24). 1*s.* 6*d. each.*
County diagrams, showing civil parishes, with a table of their area. Pembrokeshire. 6*d.*

1-inch—(third edition):—

Outline, 198, 231. 1*s. each* (engraved).
With hills in black or brown, 198, 231. 1*s. each* (engraved).
Large-sheet Series, printed in colours, folded in cover or flat in sheets, 50, 116, 124, 126. *On paper*, 1*s.* 6*d.*; *mounted on linen*, 2*s.*; *mounted in sections*, 2*s.* 6*d. each.*

6-inch—County Maps :—

Hampshire, 7 sheets. **Kent**, 17 sheets. **Lancashire**, 1 sheet. **Yorkshire**, 17 sheets. *Price* 1*s. each.*

25-inch—County Maps :—

Cheshire, 22 sheets. **Hampshire**, 27 sheets. **Lancashire**, 8 sheets. **Sussex**, 32 sheets. **Yorkshire**, 90 sheets. 3*s. each.*

(*E. Stanford, London Agent.*)

England and Wales. **Geological Survey.**

4 miles to 1 inch :—

New Series, colour printed. Solid edition (21 and 25). 2*s.* 6*d.*

1-inch map :—

New Series, colour printed. Drift edition, 347, 64. 1*s.* 6*d. each.*

(*E. Stanford, London Agent.*)

Finland.

Suomen Kruununmet-äin Kartta. [Forest map of Finland.] Scale : 1 : 800,000 or 1 inch to 12·6 stat. miles. 4 sheets. [Helsingfors], 1906.

A general map of Finland, showing forests by green tinting. Besides this special feature, a considerable amount of general information is given, and the map is clearly printed in colours.

Germany. **K. Preuss. Landesaufnahme.**

Karte des Deutschen Reiches. Scale 1 : 100,000 or 1 inch to 1·6 stat. mile. Sheets : (Kupferdruck Ausgabe) 362, Ballenstedt ; 574, Heilbronn. Berlin : R. Eisenschmidt, 1909.

Spain. **Instituto Geografico y Estadistico, Madrid.**

Mapa Topografica de España. Scale 1 : 50,000 or 1·3 inch to 1 stat. mile. Sheet 1022, Campillos. Madrid : Instituto Geografico y Estadistico, 1909.

ASIA.

Borneo. **Topographical Bureau, Batavia.**

Overzichtskaart van het eiland Borneo. Scale 1 : 2,000,000 or 1 inch to 31·5 stat. miles. Batavia : Topographical Bureau, 1909.

A new edition of a general map of Borneo. Shows clearly the location of various minerals by coloured symbols, in addition to other useful information.

Celebes. **Topographical Bureau, Batavia.**

Overzichtskaart van het eiland Celebes. Scale 1 : 1, 250,000 or 1 inch to 19·7 stat. miles. Batavia : Topographical Bureau, 1909.

A useful map of the island of Celebes, compiled from the latest information, and well produced in colours. In addition to the general map there are two insets of the island, one showing political divisions and means of communication, and the other the density of population. There are also tables of the imports and exports.

Indian Government Surveys. **Surveyor-General of India.**

India and adjacent countries : scale 1 : 1,000,000 : Persia 2 sheets, Bombay Presidency 1 sheet ; 1 inch to 1 mile : North-West Frontier Provinces 12 sheets, Bombay 9 sheets, Madras 1 sheet, Punjab 6 sheets, United Provinces 4 sheets, Central Provinces and Berar 8 sheets, Bengal 8 sheets, Eastern Bengal and Assam 1 sheet, Burma 2 sheets. India, 1 inch to 64 miles. Frontier Surveys : North-West Trans-Frontier, 1 inch to 4 miles, 1 sheet. Bengal : Provincial map, 1 inch to 32 miles ; Bengal Survey, 1 inch to 1 mile, 8 sheets. Bombay Survey, 1 inch to 1 mile, 1 sheet ; Levels in Sind, 1 inch to 2 miles, 1 sheet. Burma : Provincial map, 1 inch to 32 miles ; Burma Survey, 1 inch to 1 mile, 3 sheets. Central India and Rajputana : C. I. Agency, 1 inch to 16 miles ; Rajputana Agency, 1 inch to 16 miles ; Central India and Rajputana Survey, 1 inch to 1 mile, 5 sheets. Central Provinces, 1 inch to 32 miles ; Central Provinces Survey, 1 inch to 1 mile, 4 sheets. Eastern Bengal and Assam, 1 inch to 32 miles ; Eastern Bengal and Assam Survey, 1 inch to 1 mile, 4 sheets. Madras Presidency, 1 inch to 32 miles. Punjab Survey, 1 inch to 1 mile, 3 sheets ; Levels in the Punjab, 1 inch to 2 miles, 5 sheets. United Provinces : Farukhabad District, 1 inch to 4 miles ; United Provinces Survey, 1 inch to 1 mile, 17 sheets. Afghanistan, 1 inch to 32 miles. Baluchistan Agency with Sind, 1 inch to 32 miles. Eastern Turkestan, 1 inch to 32 miles. Calcutta : Surveyor-General's Office, 1909. *Presented by the Secretary of State for India, through the India Office.*

AFRICA.

Algeria. **Gouvernement Général de l'Algérie.**

Départment de l'Alger. Carte des Voies de Communication dressée par ordre de M. C. Jounart, Gouverneur-Général. Scale 1 : 400,000 or 1 inch to 5·5 stat. miles. Algiers : Gouvernement Général de l'Algérie, Service Cartographique, 1909. *Presented by M. R. de Flotte Roquevaire, Chef de Service Cartographique.*

One of a series of outline maps of Algeria, without hills, showing means of communication. Railways and roads, open, under construction, and projected, are clearly distinguished, whilst their character and relative importance are also indicated by the symbols employed.

AMERICA.

Argentina—Buenos Aires. **Dept. de Obras Publicas, Buenos Aires.**

Plano de la Ciudad de Buenos Aires, Capital de la Republica Argentina con el Trazado General de Calles. Confeccionado por el Departamento de Obras Publicas de la Municipalidad. Scale 1 : 10,000 or 6·3 inches to 1 stat. mile. Twelve sheets. Buenos Aires : Departamento de Obras Publicas de la Municipalidad, 1907. *Presented by H. Frank Previté, Esq.*

A large-scale plan of the city of Buenos Aires in twelve sheets, each measuring 28 inches by 22 inches, carefully constructed from the surveys and plans in the Department of Public Works of that city.

Colombia. **Vergara y Velasco.**

Atlas Complete de Geografia Colombiana por Francisco Javier Vergara y Velasco. Parts 1–5. Bogota : Imprenta Eléctrica, 1906.

This is the sixth part of an atlas of the Republic of Colombia, of which the publication was commenced in 1906. Each part contains about twelve maps, accompanied by text, dealing with the general and physical geography, geology, history, and population of the country; in addition to which are plans of towns, charts of the coast, and rivers, and numerous sections. There will be altogether eight parts, and it is intended to complete the atlas during the present year.

The cartographical material of Colombia is so scanty, and so few maps of the country exist, that any addition to our knowledge will be welcomed: but notwithstanding the fact that this atlas contains interesting information, the maps are so roughly drawn and lithographed, and are generally such crude productions, that much of the value they might have is lost. It is greatly to be regretted that instead of publishing facsimiles of the author's rough pen-and-ink drawings, it was not found possible to place the work in the hands of experienced geographical draughtsmen.

United States. **Philip.**

Philips' Comparative Series of Large School Maps. United States. Scale 1 : 3,000,000 or 1 inch to 47·3 stat. miles. London : George Philip & Son, Ltd., 1909. *Price* 14*s. mounted on rollers and varnished. Presented by the Publisher.*

Venezuela. **Ministro de Guerra y Marina, Caracas.**

Mapa General de Venezuela. Scale 1 : 1,000,000 or 1 inch to 15·8 stat. miles. Caracas sheet.—Atlas de Venezuela. Scale 1 : 250,000 or 1 inch to 3·9 stat. miles. Map No. 12.—Plano Topografico de Venezuela. Scale 1 : 50,000 or 1·3 inch to 1 stat. mile. Sheet 12–15.—Carta demonstrativa del progreso de los trabajos del Plano Militar de Venezuela. Scale 1 : 2,000,000 or 1 inch to 31·5 stat. miles.—Demonstracion de las principales diferencias entre el mapa de Venezuela por Codazzi y el mapa general de los trabajos del Plano Militar de Venezuela. Scale 1 : 1,330,000 or 1 inch to 20·9 stat. miles. Caracas : Ministro de Guerra y Marina, 1907–1909.

These are separate copies of the sheets which appeared in the memoir on the new survey of Venezuela in 1907. The survey was undertaken by the Commission appointed by General Castro, in 1904, when President of the Republic, and the above sheets comprise (1) A general outline sketch showing in red positions determined astronomically by officers of the commissions, with the corresponding positions, in black, as formerly laid down on Codazzi's map, which for many years has formed the only map of the country on anything like a large scale. (2) Part of one of the sheets of the survey on the scale of 1 : 1,000,000, as specimen, showing Caracas and about 150 miles to the south, east, and west. (3) Sheet No. 12 of the 1 : 250,000 scale, with Caraccas, P^to Cabello,

and the country a few miles from the coast. (4) The district between Caracas and the coast, including La Guaira, on the scale of 1 : 50,000. All the sheets are printed in colours, lowlying lands being shown in green, and the hills in brown shading. There are no contours, but heights are occasionally indicated by figures. The second volume of the memoir on the survey with which these sheets were first published gives a very complete account of this important undertaking. After a short historical sketch of the previous maps of the country, it deals with the projection used in the present survey, the determination of the position of the observatory of Cajigal, Caracas, methods of computation, telegraphic determinations of longitudes. It gives also a *résumé* of the positions, barometer, thermometer, and magnetic observations, and other matters.

Hitherto the maps of Venezuela have consisted of compilations from more or less approximate route-traverses and sketches, and nothing like a reliable survey of the country has existed. It is, therefore, to be hoped that this work will not be allowed to fall through, as has been the case with other enterprises of the kind.

GENERAL.

World. **St. Martin and Schrader.**

Atlas Universel de Géographie construit d'après les sources originales et les documents les plus récents, cartes, voyages, mémoires, travaux geodésiques, etc., avec un texte analytique. Ouvrage commencé par M. Vivien de Saint-Martin et continué par Fr. Schrader. Sheet 73, États-Unis d'Amerique. Feuille Nord-Ouest. Paris: Hachette & Cie., 1909. *Presented by the Publisher.*

This sheet completes the four-sheet map of the United States published in this atlas on the scale of 1 : 5,000,000. Like the others of the series, it is well drawn and engraved; but, as has been pointed out before in regard to other sheets, owing to the fact that the hillwork and lettering are both in black, many of the names, which are very small, are almost illegible in the mountainous regions, and the map in this part is very confused in its appearance.

CHARTS.

Admiralty Charts. **Hydrographic Department, Admiralty.**

Charts and Plans published by the Hydrographic Department, Admiralty, during October, 1909. *Presented by the Hydrographer, Admiralty.*

New Charts—No. 645, Plans on the coast of Peru: Lobitos to La Cruz bay, Lobitos cove, Talara bay, 3*s.* 471, Australia, south coast: Port Adelaide harbour, 2*s.*— **New Plans and Plans added.** 1454, Anchorages in Alaska. New Plans: Shumagin islands, English bay, 3*s.*

Atlantic, North, and Mediterranean. **Meteorological Office.**

Monthly meteorological charts of the North Atlantic and Mediterranean, December, 1909. London: Meteorological Office, 1909. *Price 6d. each. Presented by the Meteorological Office.*

Atlantic, North. **U.S. Hydrographic Office.**

Pilot chart of the North Atlantic ocean, November, 1909. Washington: U.S. Hydrographic Office, 1909. *Presented by the U.S. Hydrographic Office.*

Atlantic, North. **U.S. Weather Bureau.**

Meteorological chart of the North Atlantic Ocean, January, 1910. Washington: Department of Agriculture, U.S. Weather Bureau, 1909. *Presented by the U.S. Weather Bureau.*

Indian Ocean and Red Sea. **Meteorological Office.**

Monthly meteorological charts of the Indian Ocean north of 15° S. lat. and Red Sea, December, 1909. London: Meteorological Office, 1909. *Price 6d. each Presented by the Meteorological Office.*

Pacific, North. **U.S. Hydrographic Office.**

Pilot chart of the North Pacific Ocean, December, 1909. Washington: U.S. Hydrographic Office, 1909. *Presented by the U.S. Hydrographic Office.*

Pacific, North. **U.S. Weather Bureau.**

Meteorological chart of the North Pacific Ocean, January, 1910. Washington: Department of Agriculture, U.S. Weather Bureau, 1909. *Presented by the U.S. Weather Bureau.*

PHOTOGRAPHS.

Egyptian Sudan. **Channer.**

Twenty-four photographic negatives (films) of the Bahr-el-Ghazal, taken by Captain Hugh Channer, R.M.L.I. *Presented by Captain Hugh Channer, R.M.L.I.*

(1) Group of Niam Niam girls, Meridi; (2–4) Young Dinka girls carrying pitchers of water, Lao Post; (5 and 6) Group of Dinka warriors, Lao Post; (7) Dinka girl with pitcher of water; (8) Bakka girl, Meridi; (9) Niam Niam girl; (10 and 11) Group of Niam Niam girls; (12 and 13) Group of Dinka "friendlies" being addressed prior to accompanying a punitive patrol, Lao Post; (14) "Sakia," or water-wheel, Rumbek; (15) Bakka women carrying pitchers, Meridi; (16) Bakka wife of local sheikh; (17) Niam Niam prisoner brought in by local sheikh, Meridi; (18) Bakka girl and dog, Meridi; (19) Native woman; (20) Bakka wife of a local sheikh, Meridi; (21) Niam Niam women, Meridi; (22) Timber bridge built by Sudanese soldiers over the Meridi river; (23) Native dancers, Meridi; (24) Scene on the White Nile.

Mesopotamia. **Willcocks.**

Thirty-seven photographs of Mesopotamia, taken by Sir William Willcocks, K.C.M.G., *Presented by Sir William Willcocks, K.C.M.G.*

As will be gathered from the titles, these photographs have a special historical importance, and give a good idea of the present condition and general characteristic features of this interesting region. Most of them were shown as lantern-slides when Sir William Willcocks read his paper before the Society in November last.

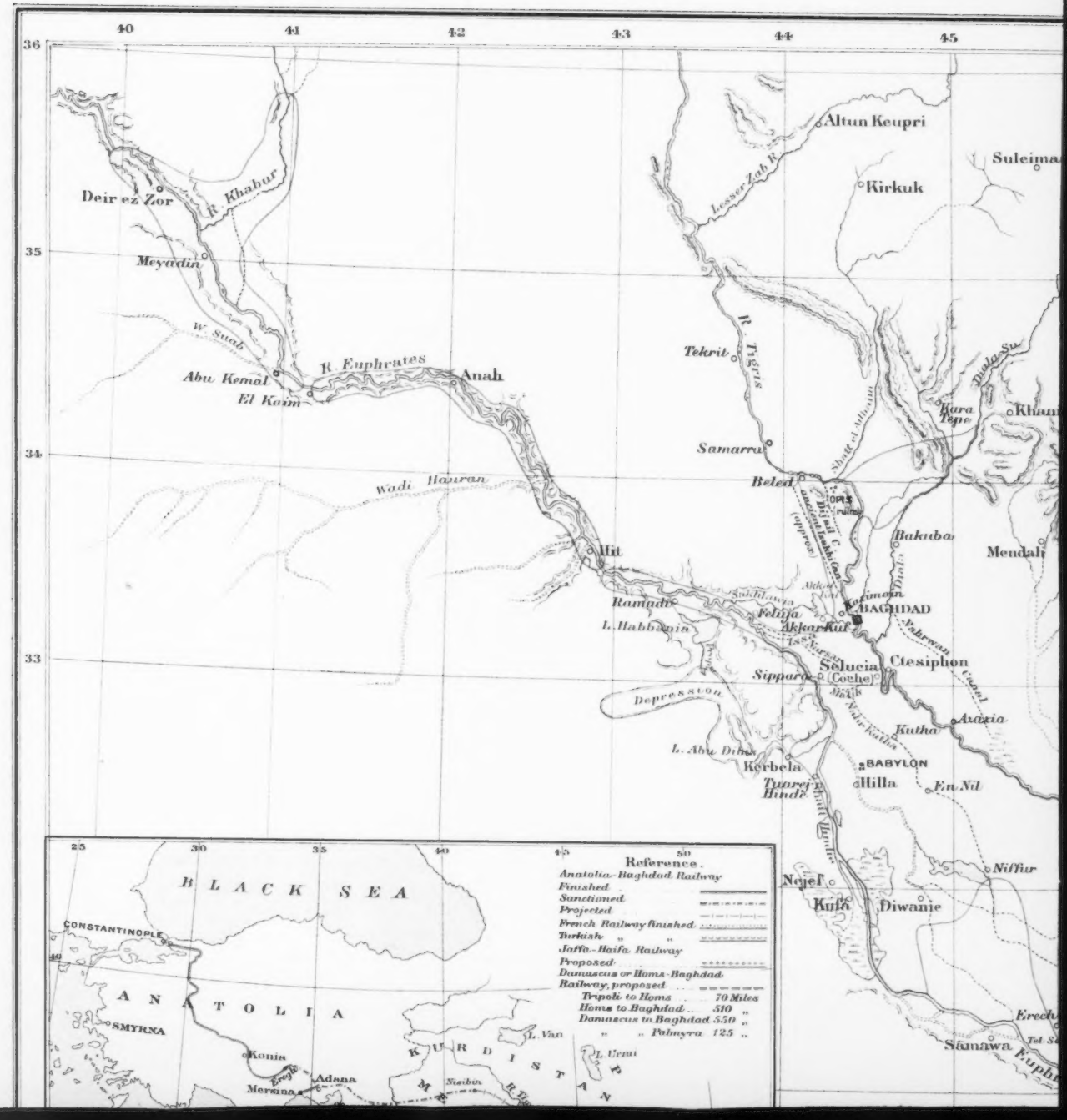
(1–3) Baghdad; (4 and 5) The British Residency, Baghdad; (6) South road, Baghdad; (7) Village on the Tigris, near Ctesiphon; (8 and 9) Ctesiphon; (10 and 11) Nausherwan's palace, Ctesiphon; (12) The gate of Istar, Babylon; (13) Bull from the gate of Istar, at Nebuchadnezzar palace, Babylon; (14–17) Babylon; (18 and 19) Egra's tomb on the Tigris; (20) River Dyala at Bukuba; (21) Kulh Saleh; (22) The entrance to Khan Abu Said; (23) Amara, on the Tigris; (24) Bridge of boats at Amara; (25) The Tigris near the swamps; (26) The water returning from the swamp to the river; (27) The descent into the Adhun river; (28) Samawa, where three Imams are buried; (29) The Euphrates at Kurna; (30) The dry bed of the old Nahrwan; (31) Camp at Khan Nahrwan; (32 and 33) Tigris and Euphrates meeting; (34) Unirrigated Mesopotamia; (35) Irrigated Mesopotamia; (36) Mesopotamian boats; (37) Mounted policeman.

Switzerland. **Vautier-Dufour.**

Vue des Alpes avec mer de brouillards prise du Chasseron. Jura Vaudois. Cliché Vautier-Dufour de Grandson. Ste. Croix: Société pour le Développement de Ste. Croix, [1909]. *Presented by M. Aug. Vautier-Dufour.*

The photographs from which this beautiful panorama has been reproduced were taken by M. Aug. Vautier-Dufour, on November 1, 1908, with his new telephotographic lens called the "Telephot," from Chasseron (Vaud) in the Jura, at an altitude of 5277 feet. The complete view consists of ten plates joined together, each measuring 7·09 × 9·45 inches (18 × 24 centimetres), and the exposure allowed was ten seconds for each plate. Above the clouds are seen, in remarkable distinctness, amongst many other important peaks, Mount Semnoz (56 miles distant), Aig. Percée (61 miles), Mont Blanc (71 miles), Dent du Midi (50 miles), Grand Muveran (51 miles), Dent Blanche (76 miles), Dom des Mischabel (87 miles), Balmhorn (62 miles), Jungfrau (70 miles), and Tödi (112 miles). Notwithstanding the great distances, the special telephotographic lens brings out the detail in a most remarkable manner, and M. A. Vautier-Dufour is to be congratulated on his success, a success which he states has only been attained after many disappointing attempts, chiefly due to weather conditions.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.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Akkar Kuf
BAGHDAD
Sippara
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KURDISTAN
L. Urmi
Reference.
Anatolia-Baghdad Railway
Finished
Sanctioned
Projected
French Railway finished
Turkish "
Jaffa-Haifa Railway
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Railway, proposed
Tripoli to Homs 70 Miles
Homs to Baghdad 510 "
Damascus to Baghdad 550 "
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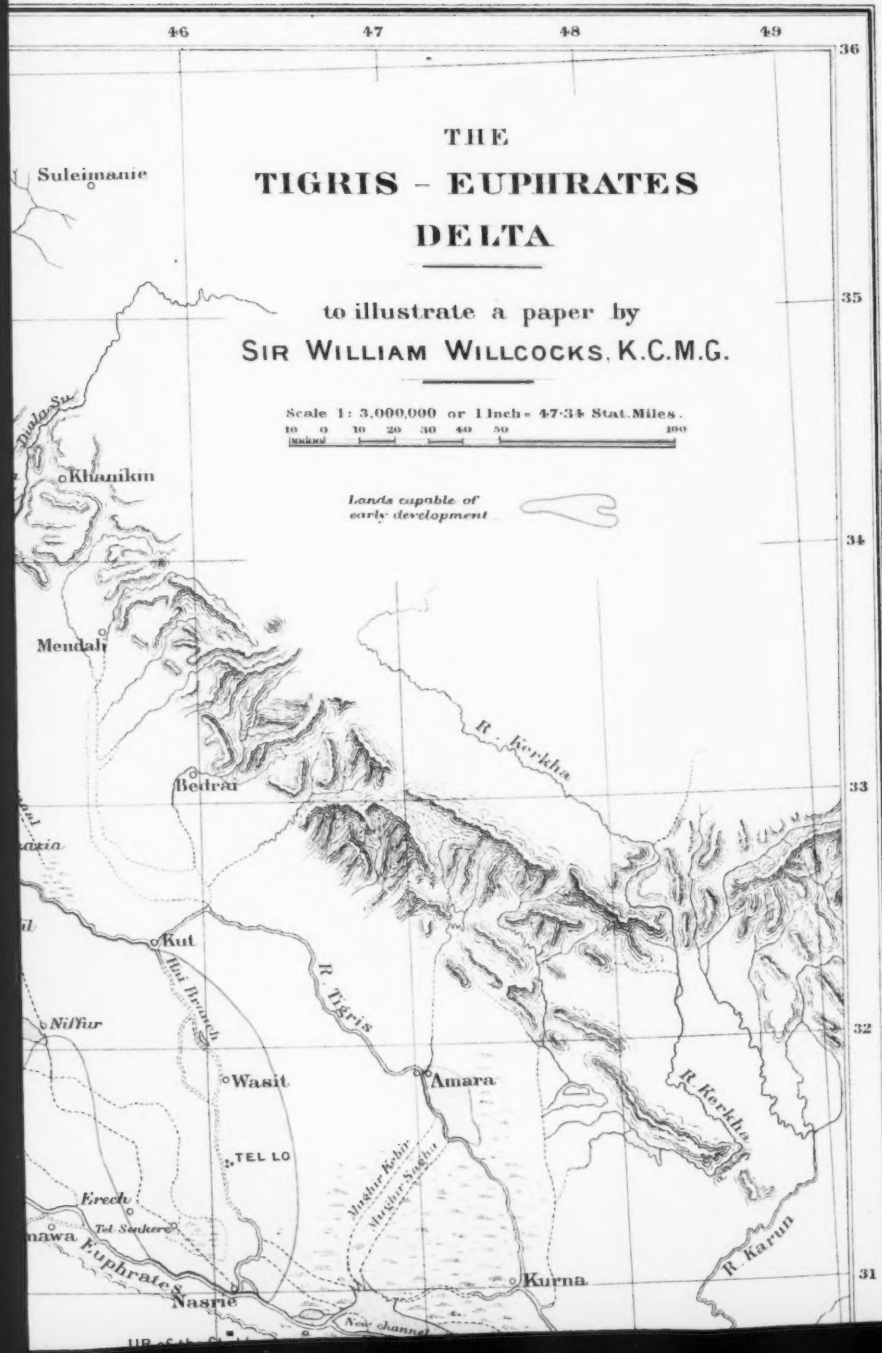
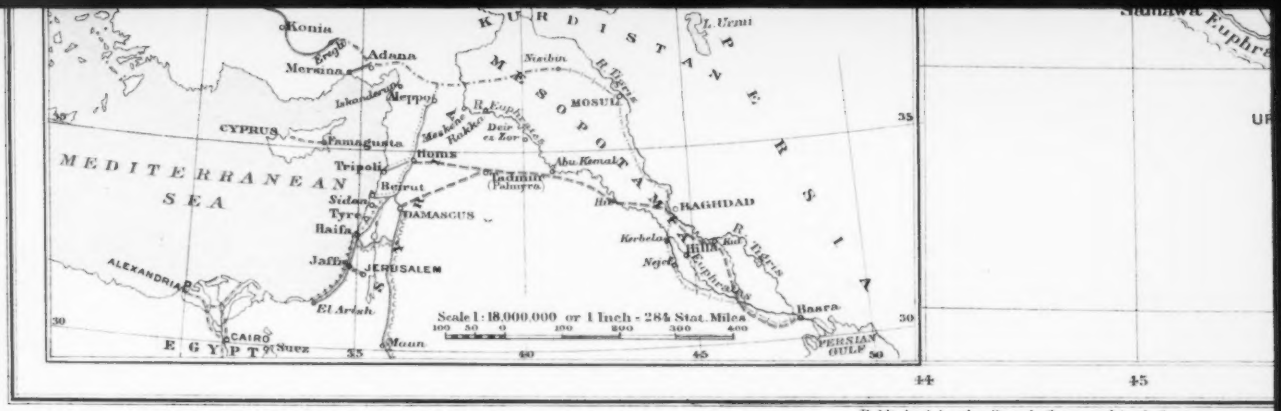
THE GEOGRAPHICAL JOURNAL 1910





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Euphrates
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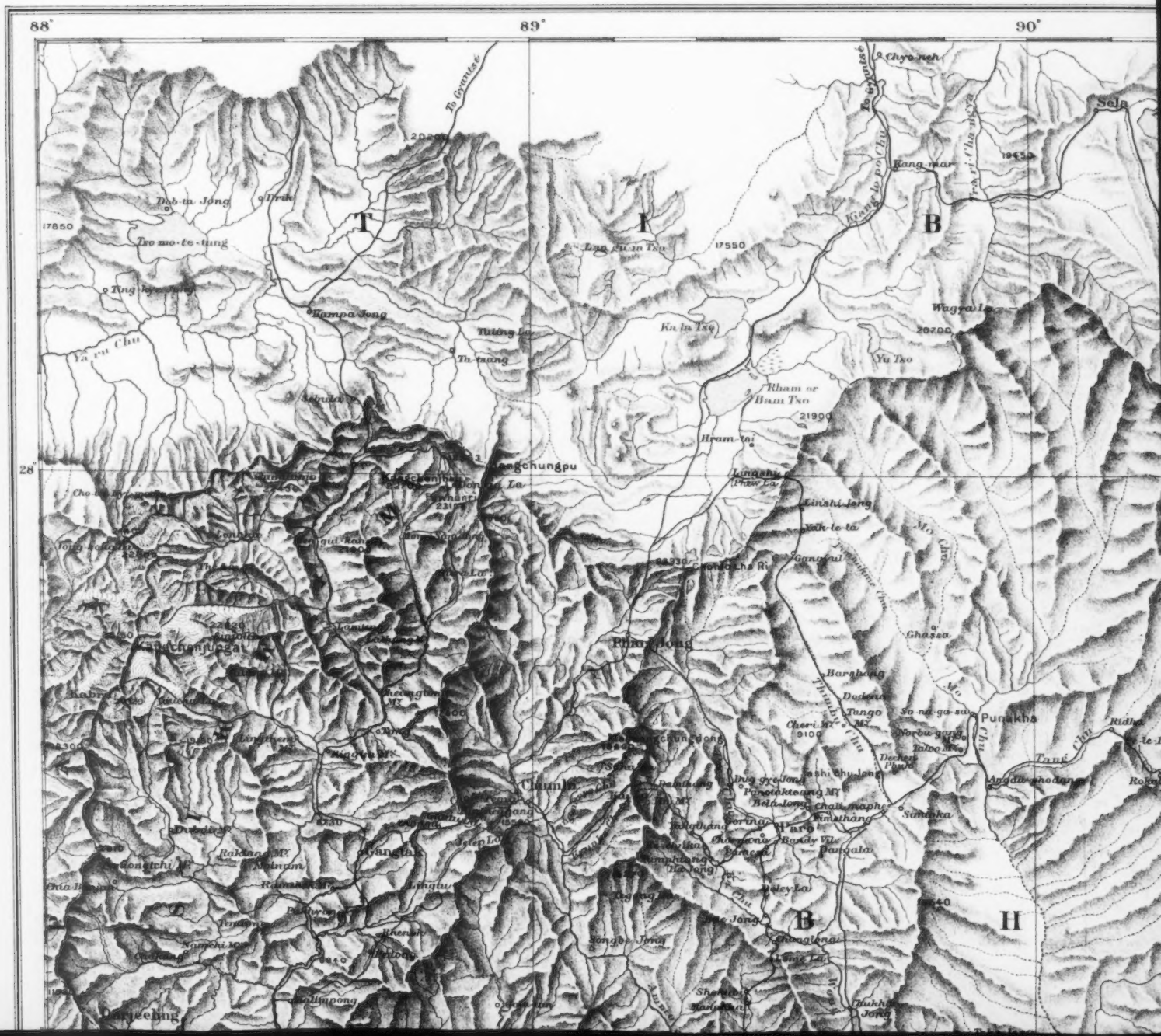
Society.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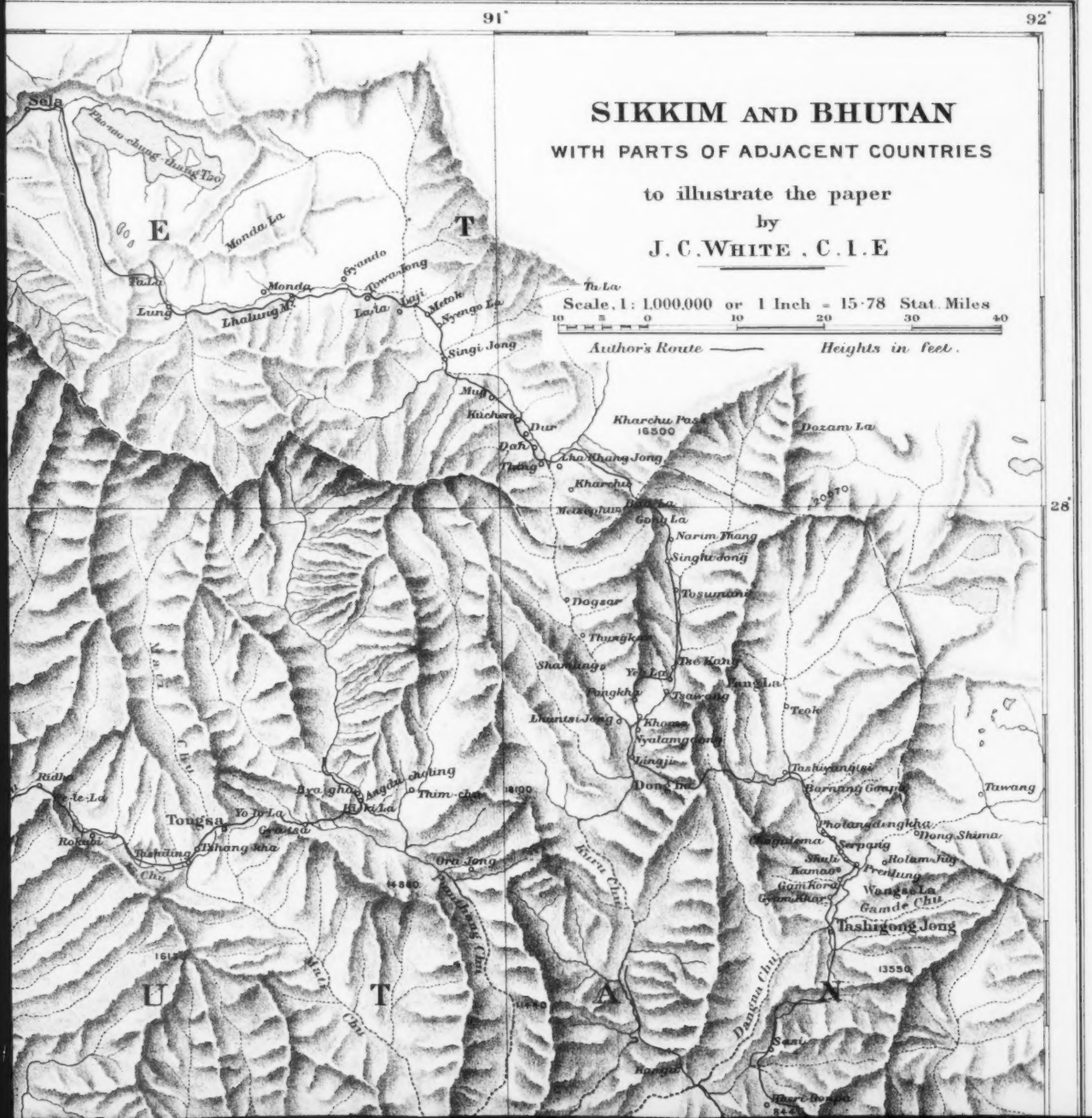
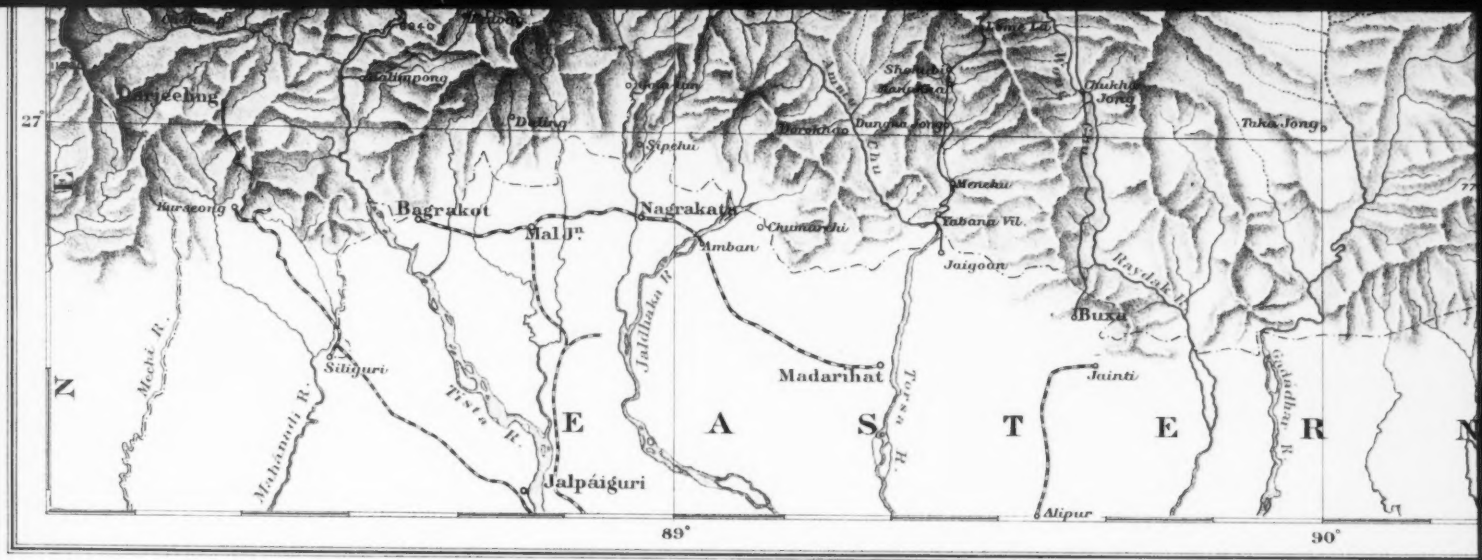
THE GEOGRAPHICAL JOURNAL 1910





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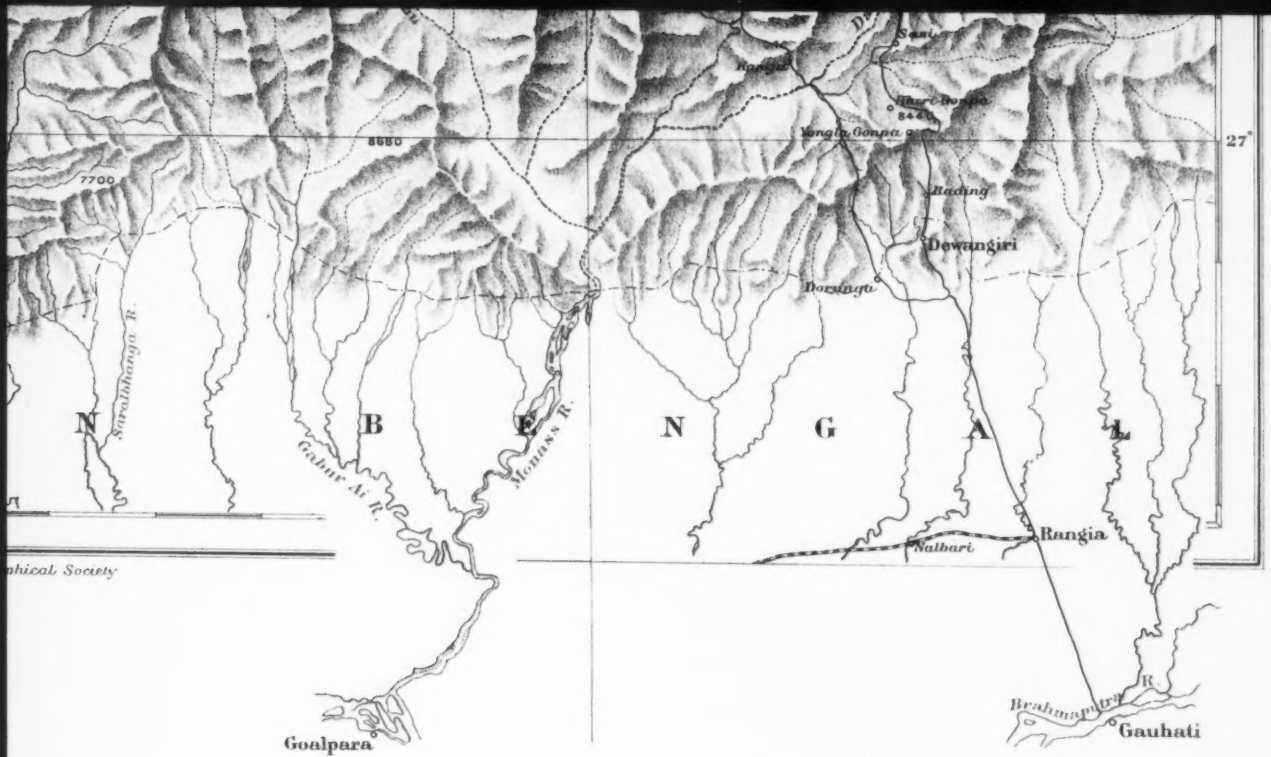
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